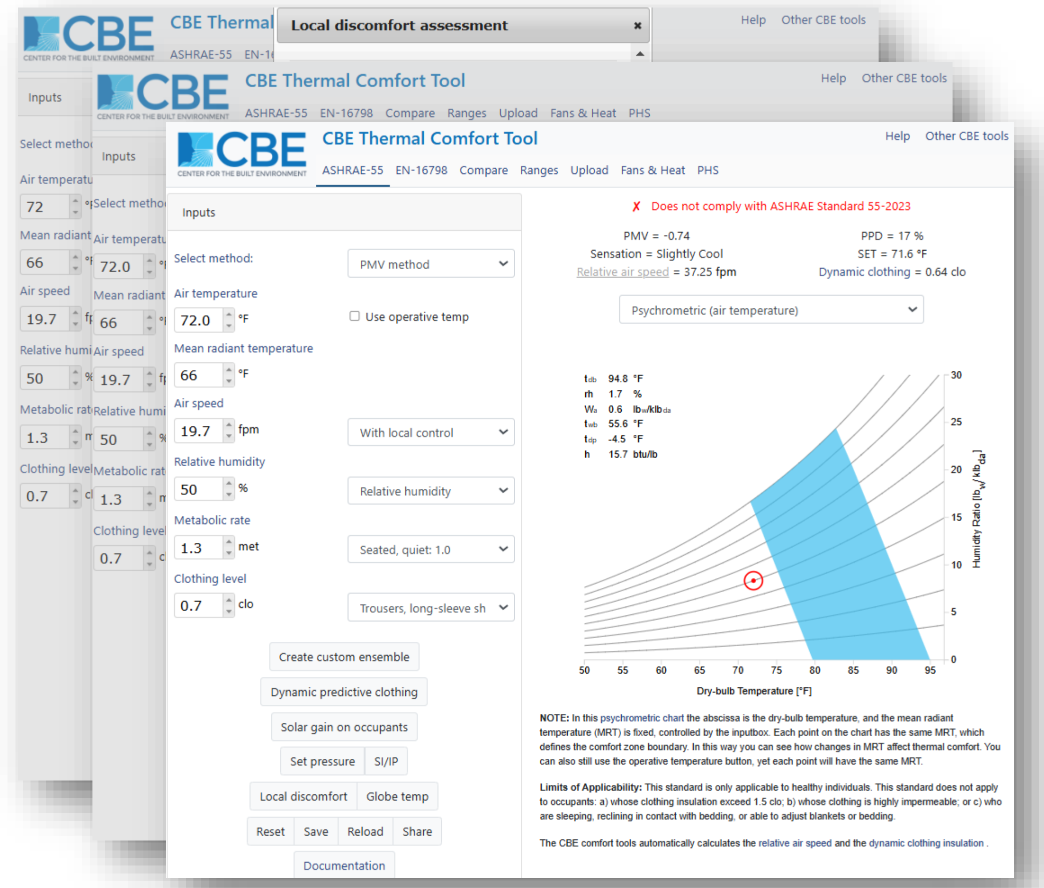
What's in the Thermal Comfort Tool?

Free Accessible Thermal Comfort Tool

- https://comfort.cbe.berkeley.edu/
- Inputs for
  - Personal Factors
  - General Factors
  - Local Factors
- Calculator
  - Clothing Predictor
  - Solar Gain Calculator
- Additional Calculators
  - Mean Radiant Temperature
  - Ceiling Fan Influencer
- Dual units (SI and I-P), examples shown in I-P
- Click here to view Case Studies



Graphic source: ASHRAE Thermal Comfort Tool, Hosted by Center for the Built Environment, Adapted Credit: Robert Bean, free use granted when credited

Thermal Comfort Tool : Case Study 1

Case Study 1

The entered air temperature (t_{db}) is similar to the MRT, indicating a higher-performing exterior zone or interior zone. The airspeed is unremarkable. The humidity is in the lower range. The met rate and clothing indicate a typical home office or office with a relaxed clothing policy.

Shows compliance

Occupant within the environmental boundaries of compliance.

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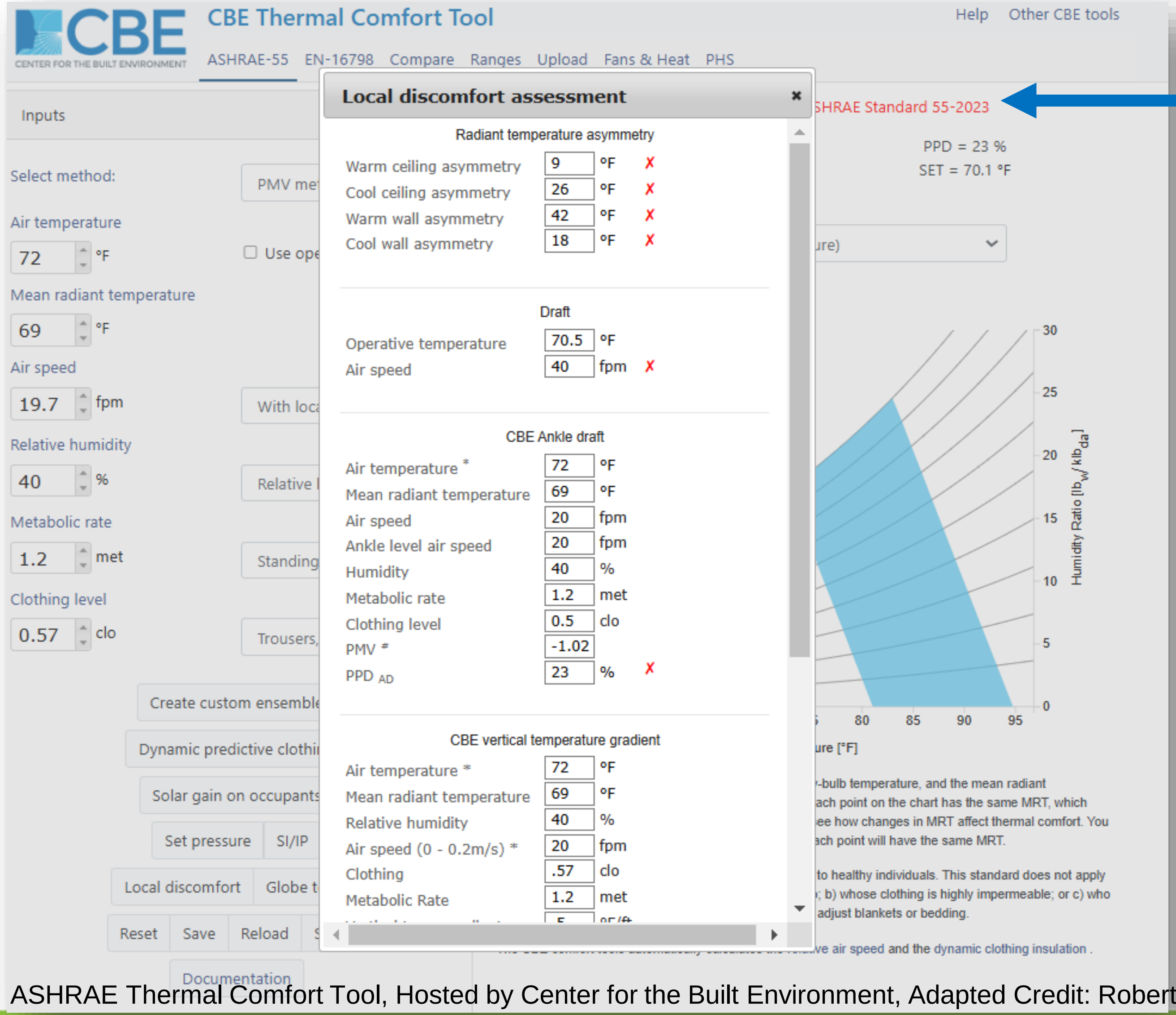
Thermal Comfort Tool : Case Study 1

Case Study 1 – Part 2a

Local discomfort assessment.

Threshold values for non-compliance are shown. Values can be calculated, measured, or simulated using CFD.

Ankle drafts are often associated with winter and are caused by warm air coming into contact with cold surfaces (glass), changing its buoyancy or displacement ventilation systems.



Shows non-compliance due to clothing and met rate

Graphic source: ASHRAE Thermal Comfort Tool, Hosted by Center for the Built Environment, Adapted Credit: Robert Bean, free use granted when credited

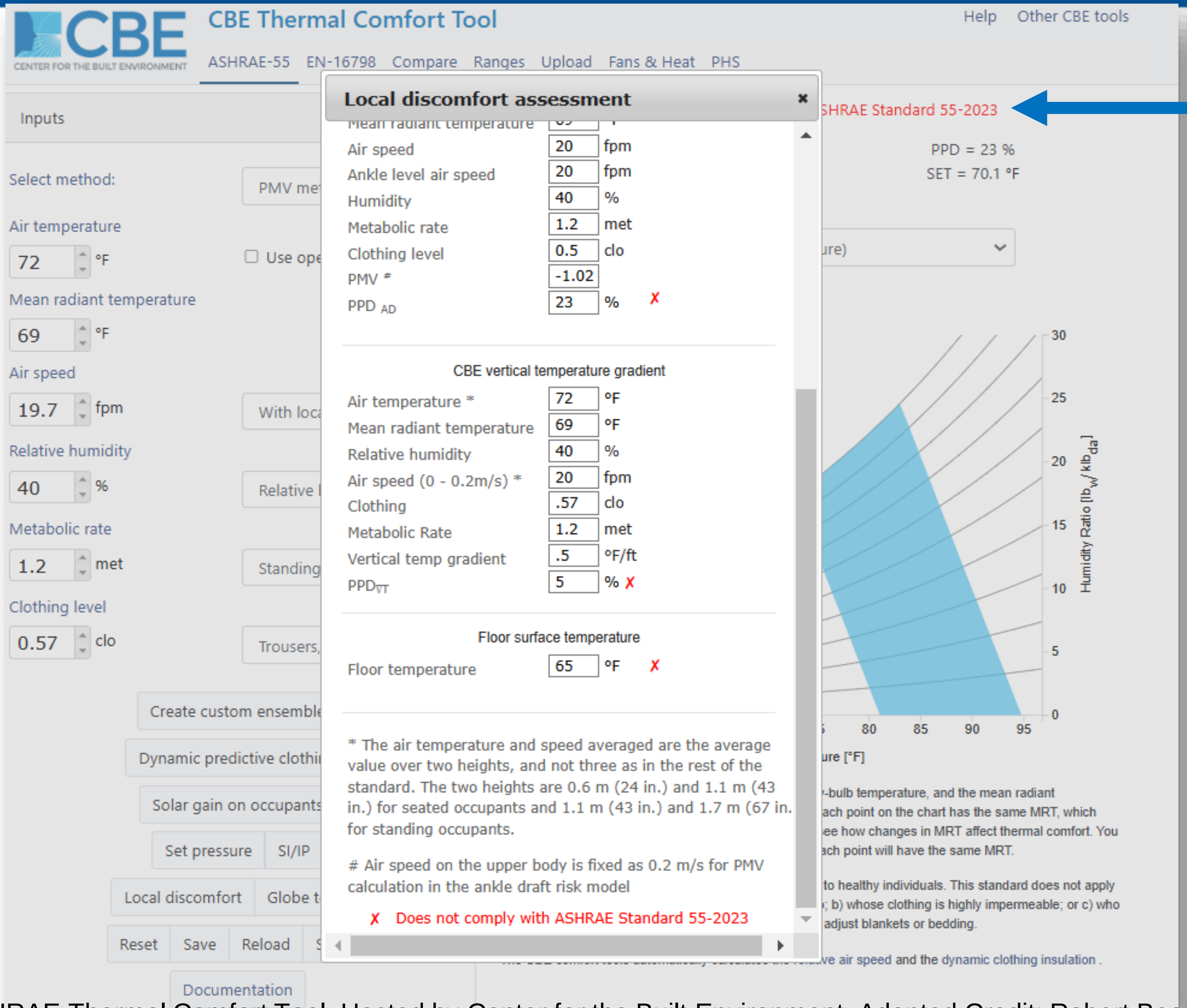
Thermal Comfort Tool : Case Study 1 *continued*

Case Study 1 – Part 2b

Local discomfort assessment.

Vertical temp. differences are caused by buoyancy & stack effect & are associated with building performance & HVAC system type.

Cool floor temps are influenced by back loss, usually due to inadequate or no insulation. High floor temps usually due to solar gains. Both can be managed with radiant floor systems.



Shows non-compliance due to clothing and met rate

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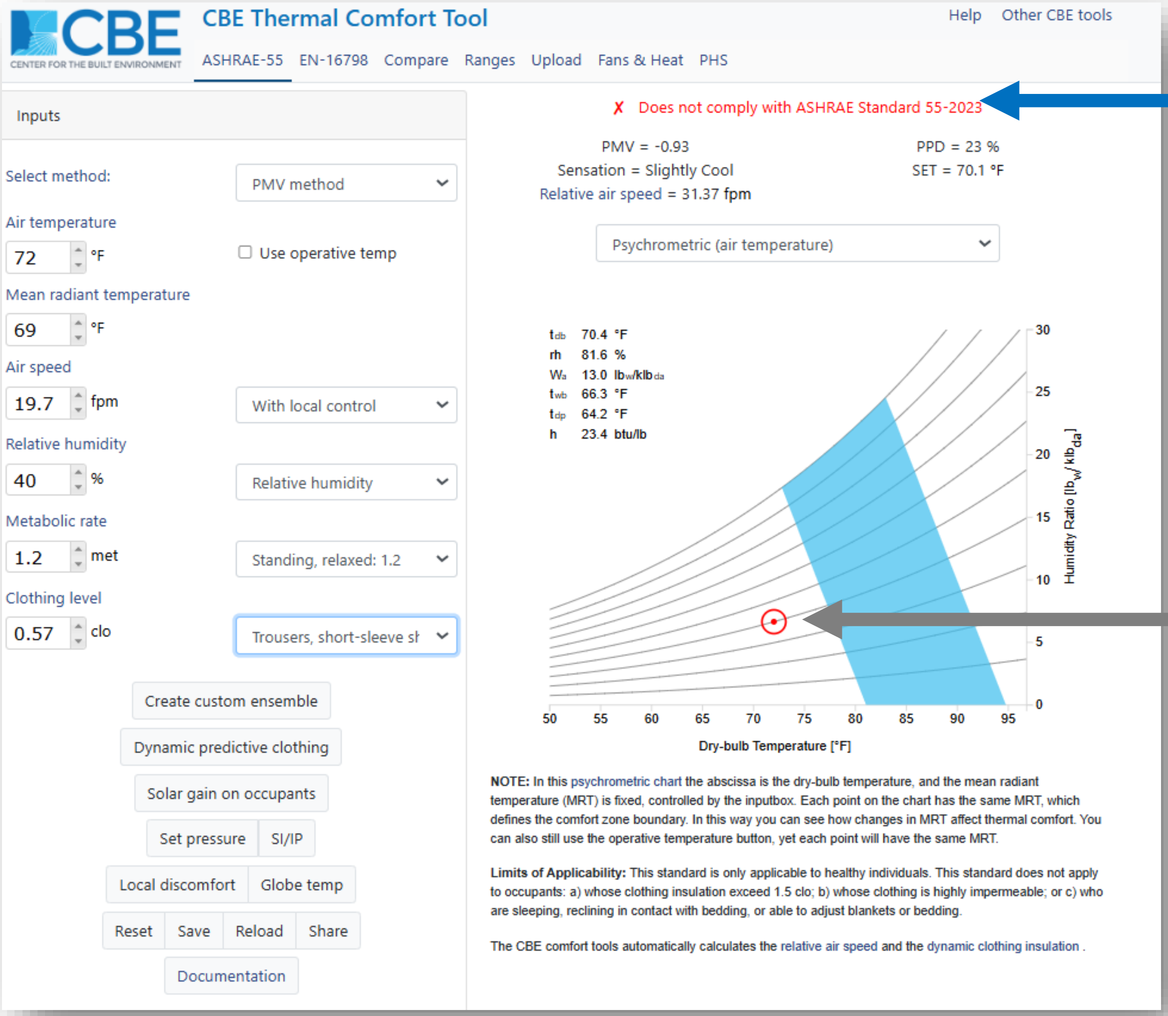
Thermal Comfort Tool: Case Study 2

Case Study 2 – Part 1

The MRT is lower than t_{db} , which is normal for buildings, even those with higher-performance enclosures, in cold to moderate climates. Airspeed is unremarkable. Humidity is in an acceptable range. <u>Met rate is below 1.3, and clothing is below 0.7. In this scenario, local discomfort must be assessed.</u>



Shows non-compliance

Occupant outside the environmental boundaries of compliance.

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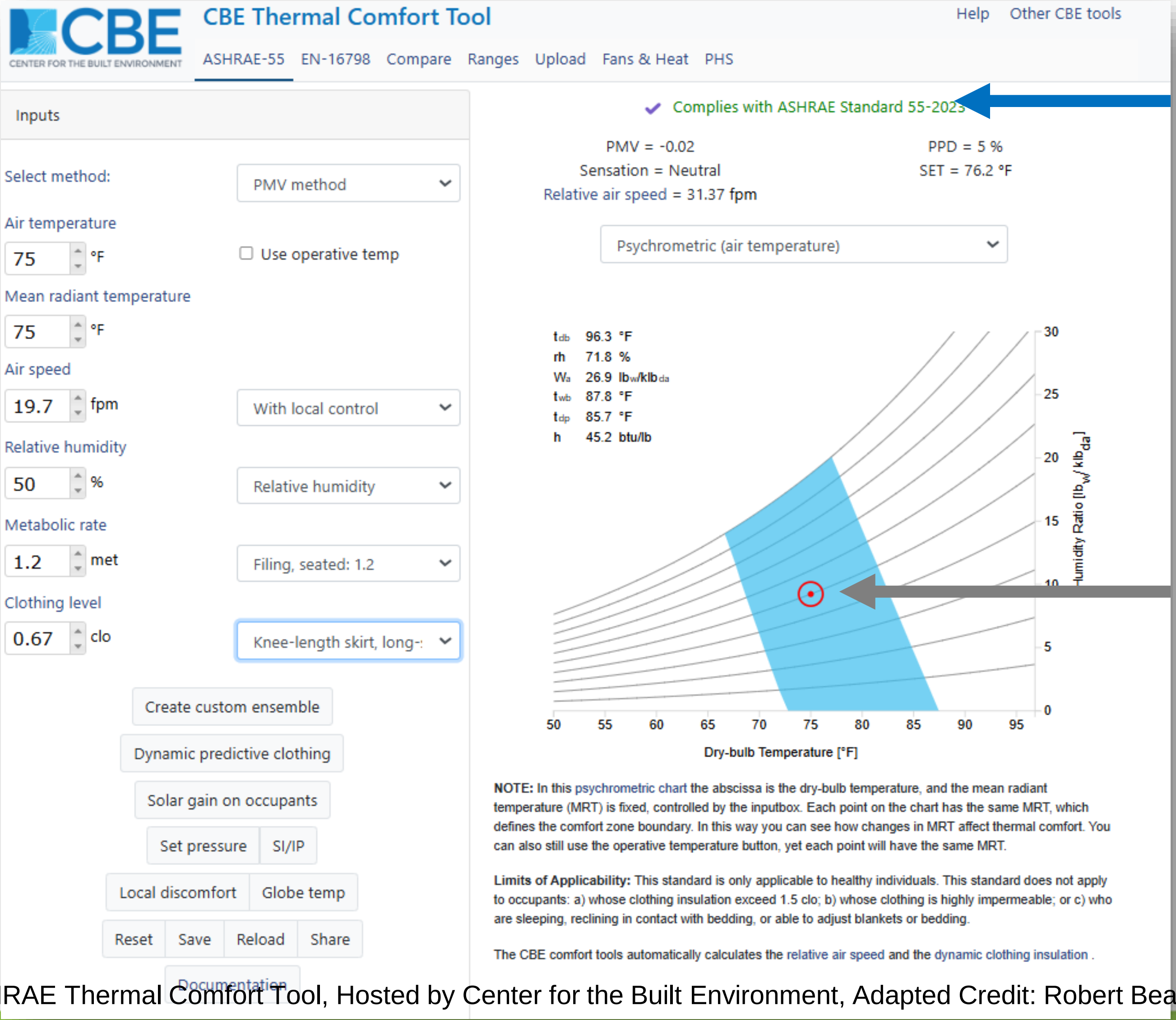
Thermal Comfort Tool: Case Study 3

Case Study 3 – Part 1

The t_{db} value equals MRT, indicating a higher-performing exterior zone in a moderate climate or interior zone. The airspeed is unremarkable. The humidity is in the mid-preferred range. The met rate and clothing indicate a typical home office or traditional office…HOWEVER…what if there is influence due to solar gains through a window?



Shows compliance

Occupant within the environmental boundaries of compliance.

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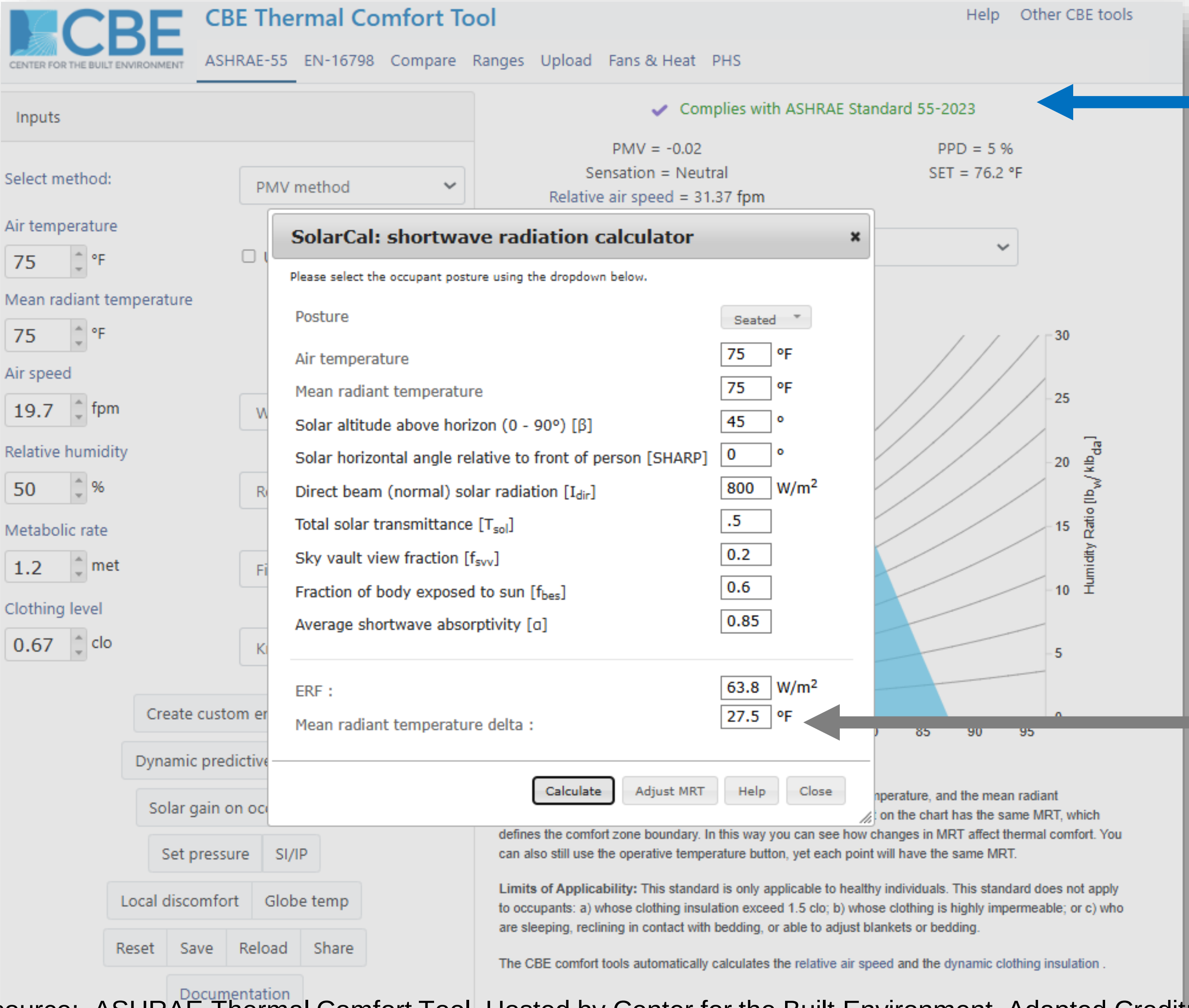
Thermal Comfort Tool: Case Study 3 *continued*

Case Study 3 – Part 2

The solar calculator develops an adjusted mean radiant (MRT) due to shortwave radiation entering a space through a window and landing on an occupant. Here, the adjustment is 27.5°F (15°C)



Shows compliance without adjustment for shortwave radiation.

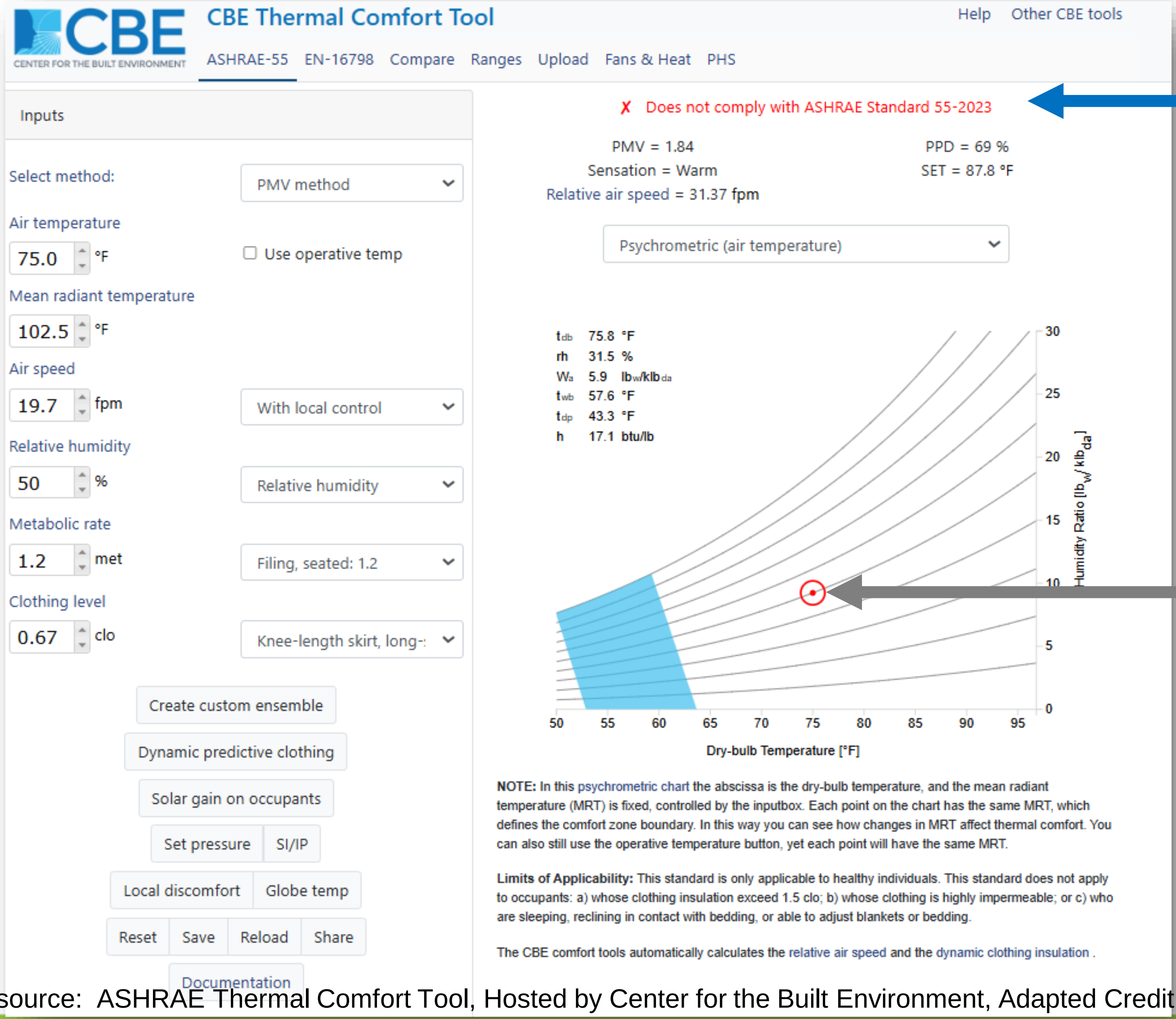
Mean radiant adjustment due to shortwave.

Graphic source: ASHRAE Thermal Comfort Tool, Hosted by Center for the Built Environment, Adapted Credit: Robert Bean, free use granted when credited

Thermal Comfort Tool: Case Study 3 *continued*

Case Study 3 – Part 3

When the MRT is adjusted by solar gains, the impact is non-trivial. It makes an otherwise compliant space noncompliant. This is why fenestration systems must be evaluated before design approval and construction. Consequently, buildings are operated cooler than necessary to compensate for solar gains.



Shows non-compliance when solar gain is considered.

Occupant outside the environmental boundaries of compliance.

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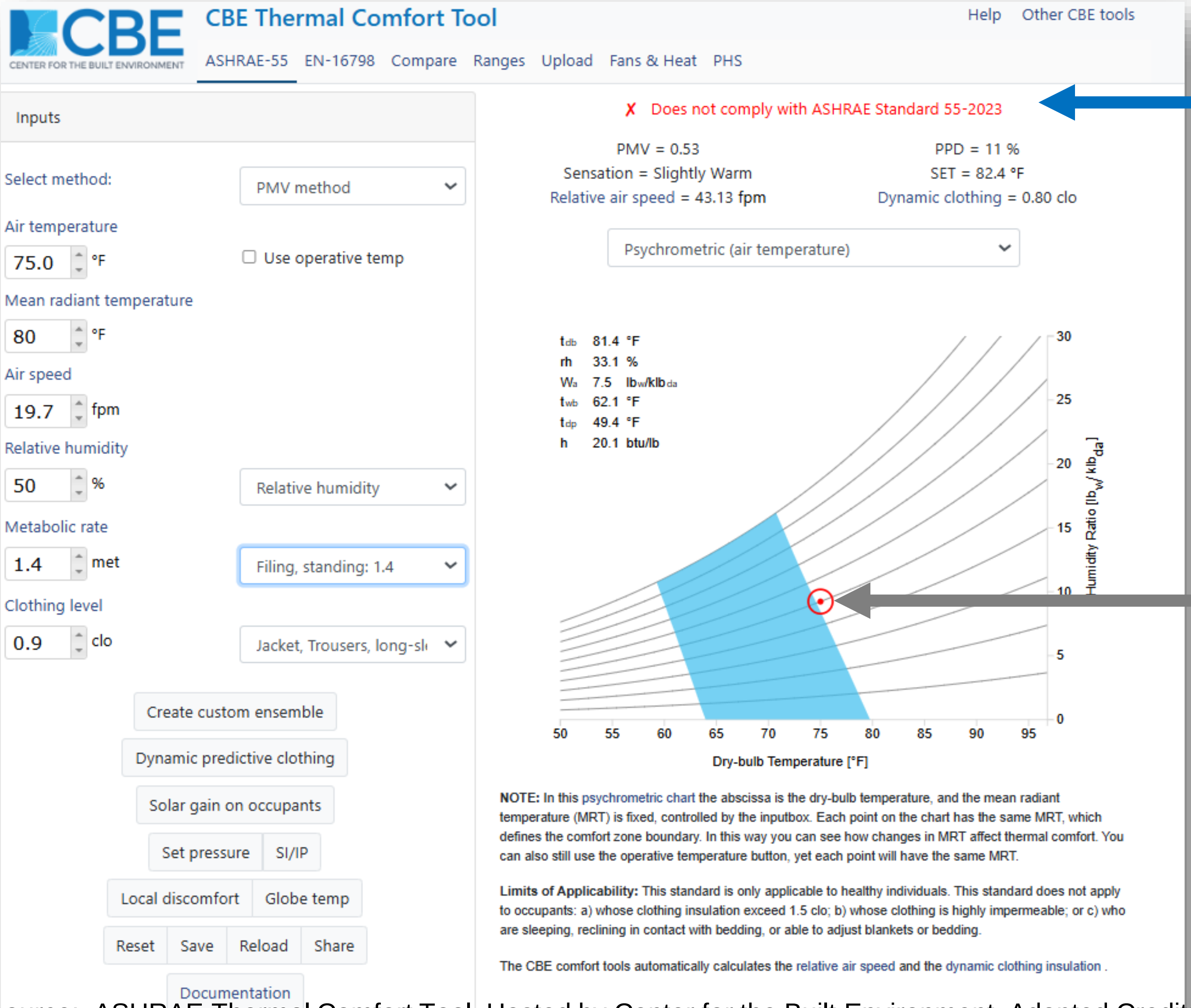
Thermal Comfort Tool: Case Study 4

Case Study 4 - Part 1

This is a summer scenario with higher t_{db} and MRT. Airspeed is unremarkable. Humidity is in the preferred mid range. However, higher met rates and office attire will lead to dissatisfaction and non-compliance due to the conditions. Option #1 is to dehumidify the space.



Shows non-compliance

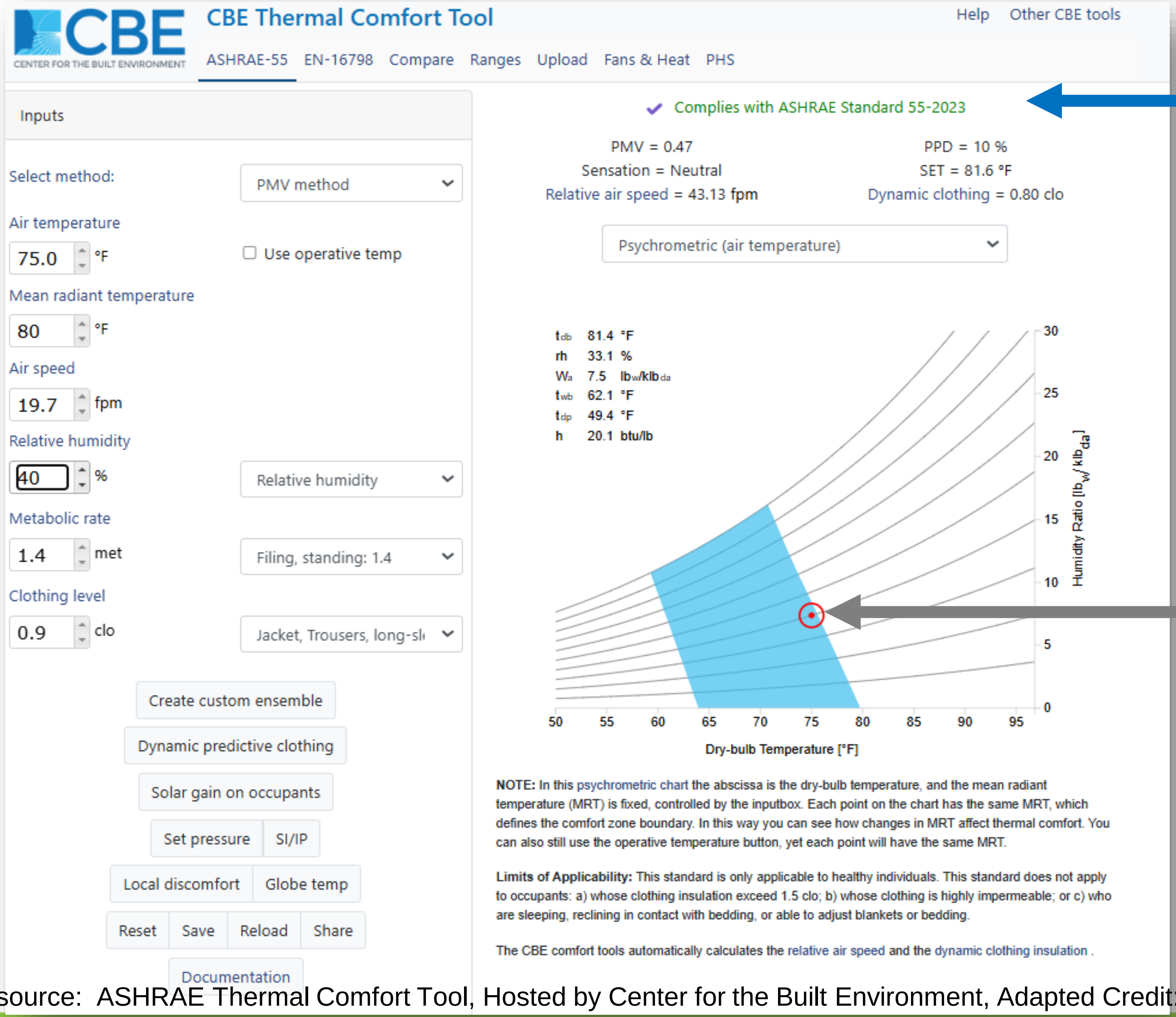
Occupant outside the environmental boundaries of compliance.

Graphic source: ASHRAE Thermal Comfort Tool, Hosted by Center for the Built Environment, Adapted Credit: Robert Bean, free use granted when credited

Thermal Comfort Tool: Case Study 4 *continued*

Case Study 4 – Part 2

By taking the humidity down by 10%, from 50% to 40%, there is a lower probability of occupant discomfort. Another option is to elevate the air speed across the occupants.



Shows compliance

Occupant inside the environmental boundaries of compliance.

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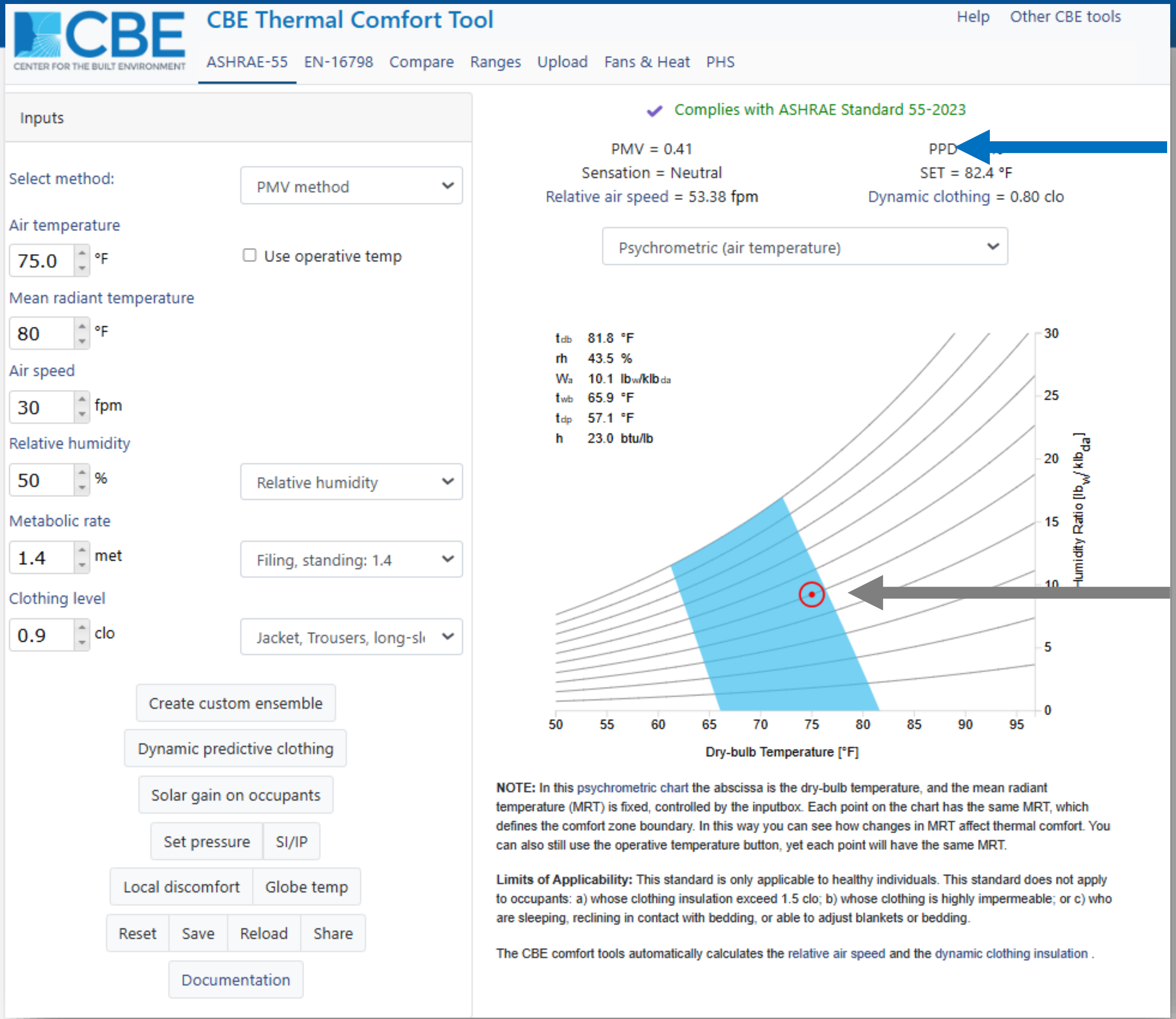
Thermal Comfort Tool: Case Study 4 *continued*

Case Study 4 – Part 3

By leaving the humidity at 50% and increasing the air velocity by 10 fpm, from 20 fpm to 30 fpm, there is a greater probability of compliance and occupant satisfaction. The designers and operators should then decide the pros/cons of adding or increasing dehumidification or adding ceiling fans (as an example)



Shows compliance

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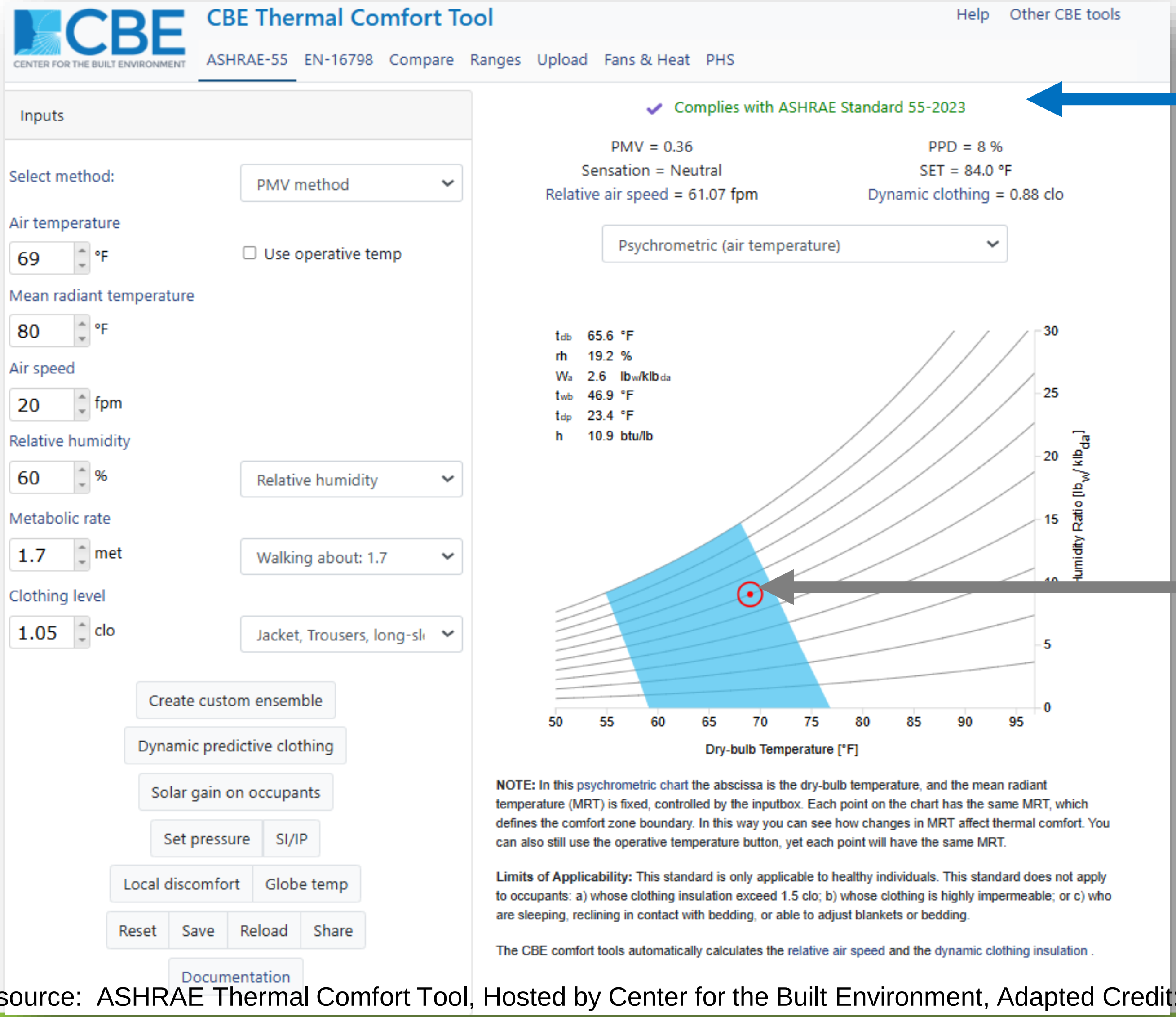
Thermal Comfort Tool: Case Study 5

Case Study 5 – Part 1

This is a summer example of an air-conditioned office with solar challenges. The office is maintained at an unnecessarily cooler temperature due to the workers' met rate (1.7) and clothing choices (1.05)….However, for those who wear lighter clothing, discomfort is highly likely.



Shows compliance

Occupant inside the environmental boundaries of compliance.

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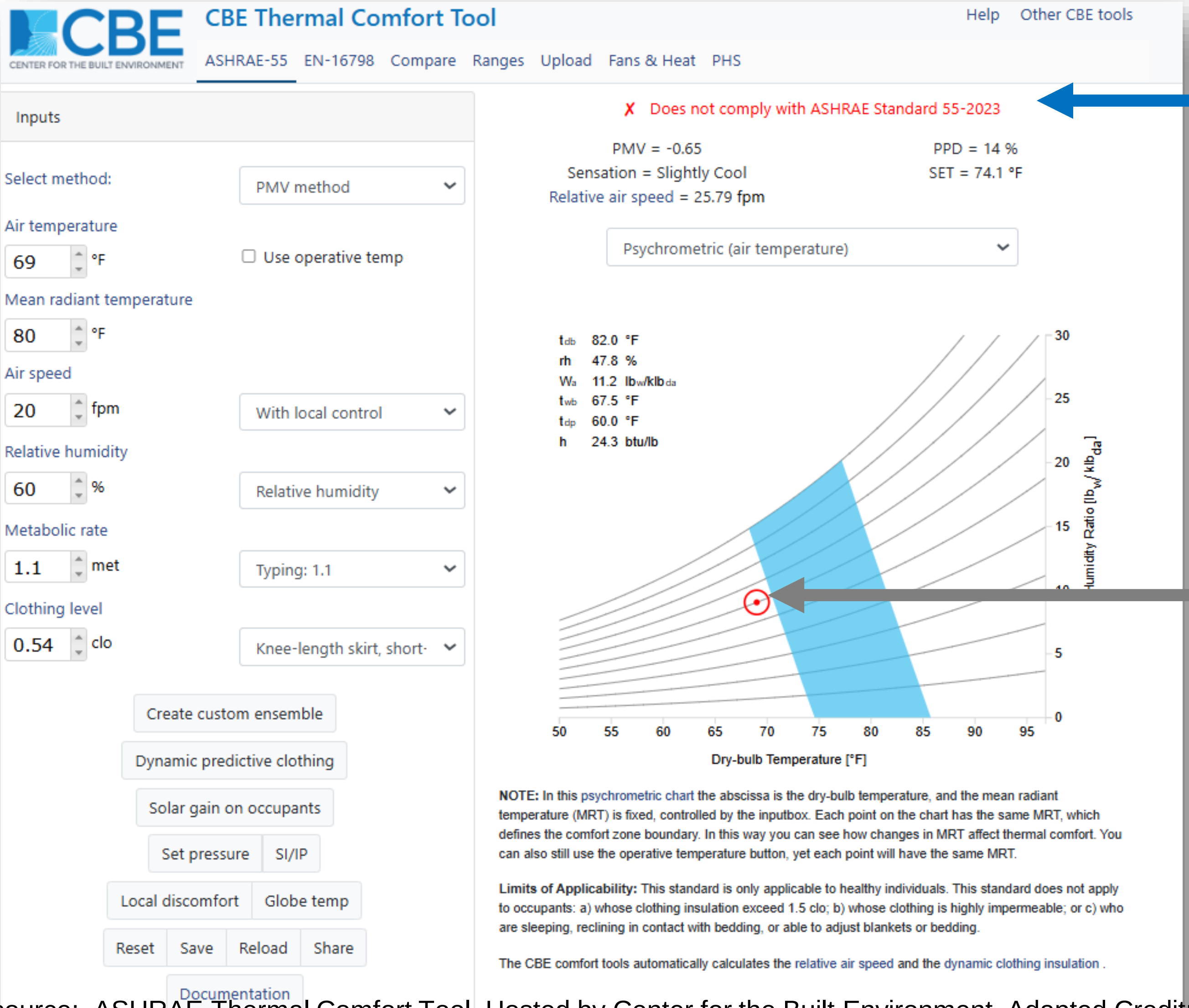
Thermal Comfort Tool: Case Study 5 *continued*

Case Study 5 – Part 5

As shown, those who wear lighter clothing (0.54) with lower met rates (1.1) will not be comfortable. The option is to encourage lighter clothing for all occupants and let the space temperatures rise. This not only improves comfort but also preserves and conserves energy.



Shows non-compliance

Occupant outside the environmental boundaries of compliance.

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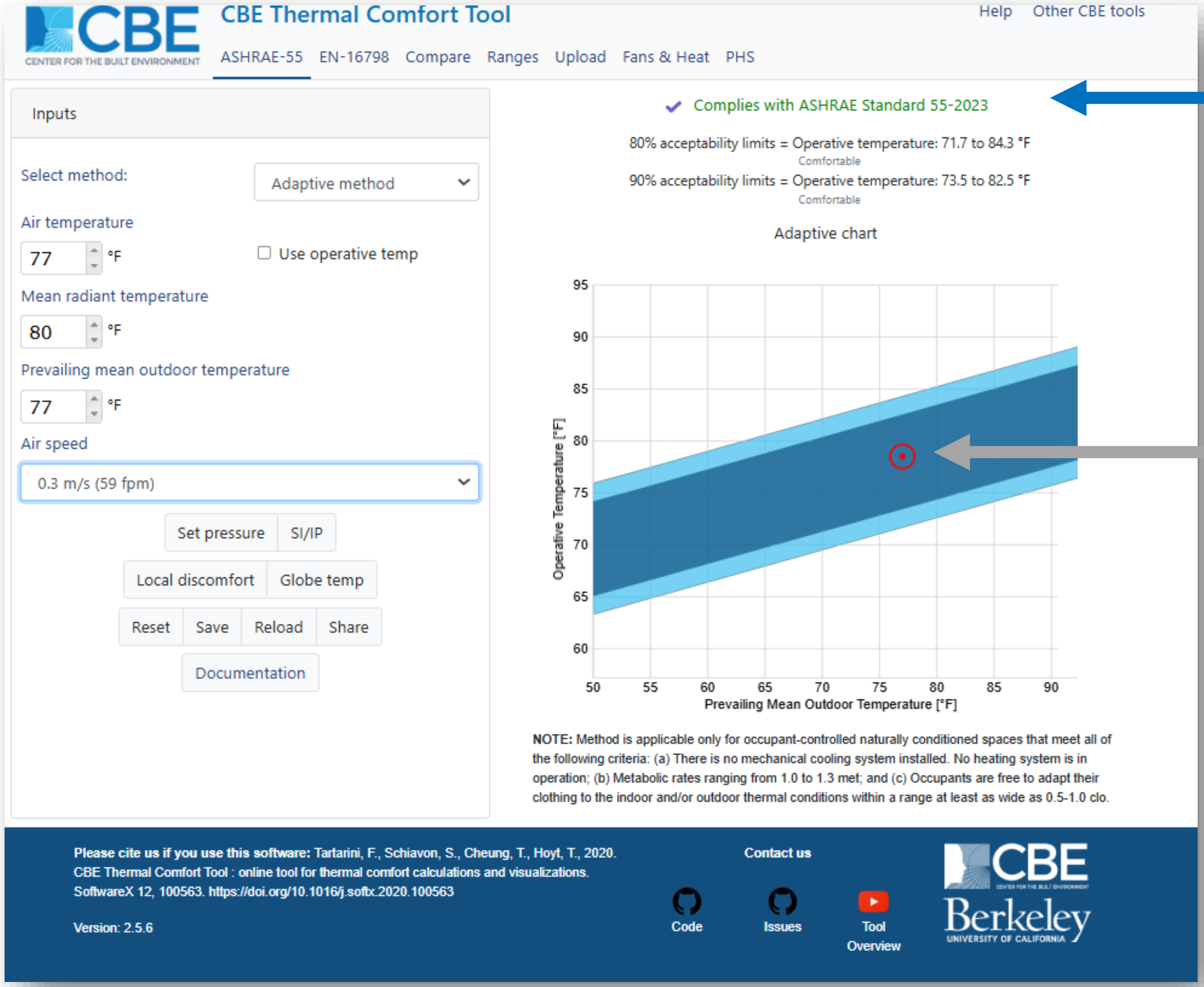
Thermal Comfort Tool: Case Study 6

Case Study 6

Adaptive comfort method is encouraged where and when it makes sense. Using this method, the outside is coupled to the inside. Practitioners should evaluate outdoor noise, air and light pollution and security risks when windows and doors are opened to the outdoors.



Shows compliance

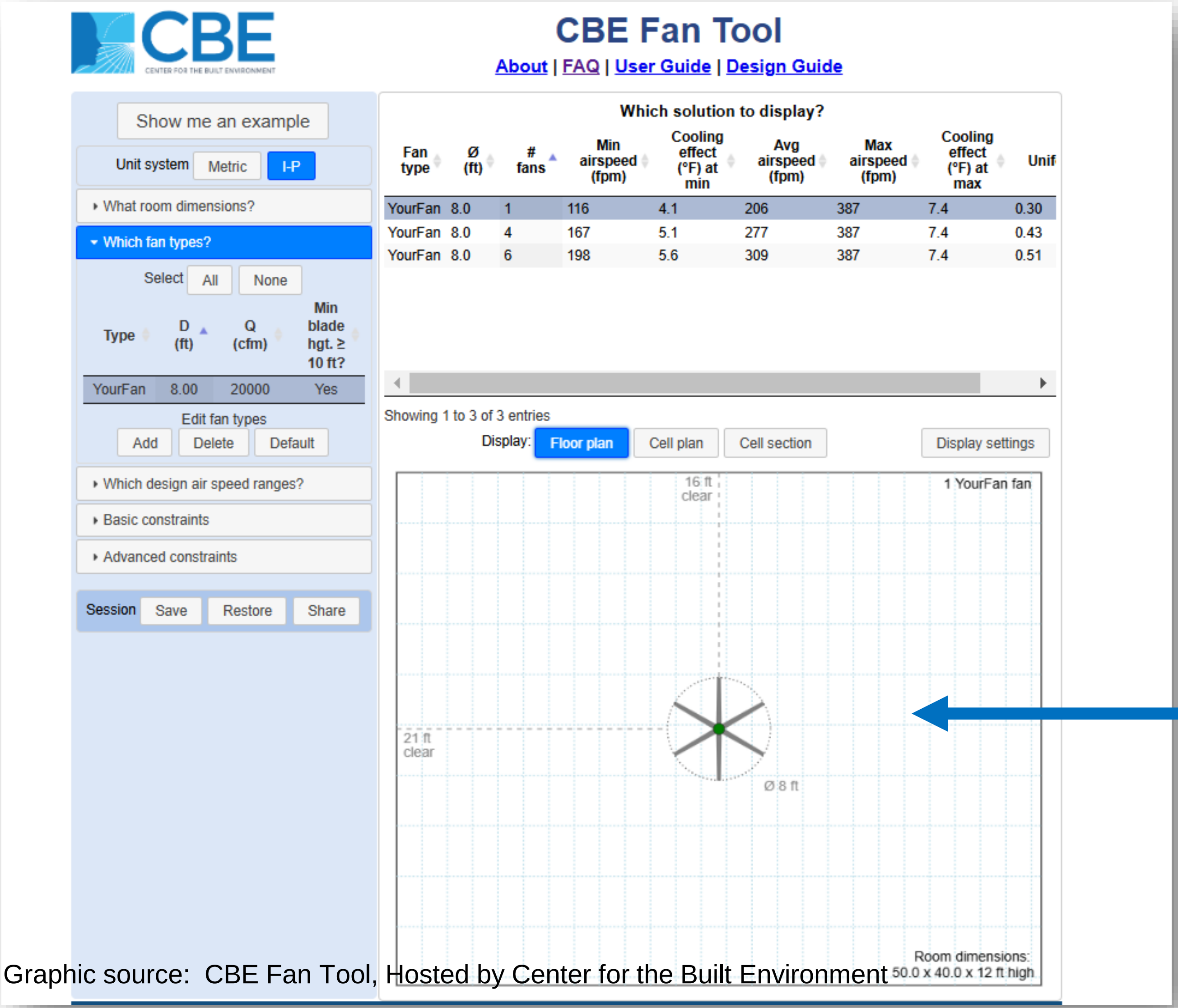
occupant inside the environmental boundaries of compliance.

Graphic source: ASHRAE Thermal Comfort Tool, Hosted by Center for the Built Environment, Adapted Credit: Robert Bean, free use granted when credited

Online Ceiling Fan Tool: Elevated Air Speeds

Using a ceiling fan simulator, the practitioner can create environments that are perceived to be cooler through increased convective flow across the body (cooling effect)…this effect can be ramped up, if necessary, by lowering the dry bulb temperature and if necessary, the humidity.

[Click here to view Case Studies]



Graphic source: CBE Fan Tool, Hosted by Center for the Built Environment

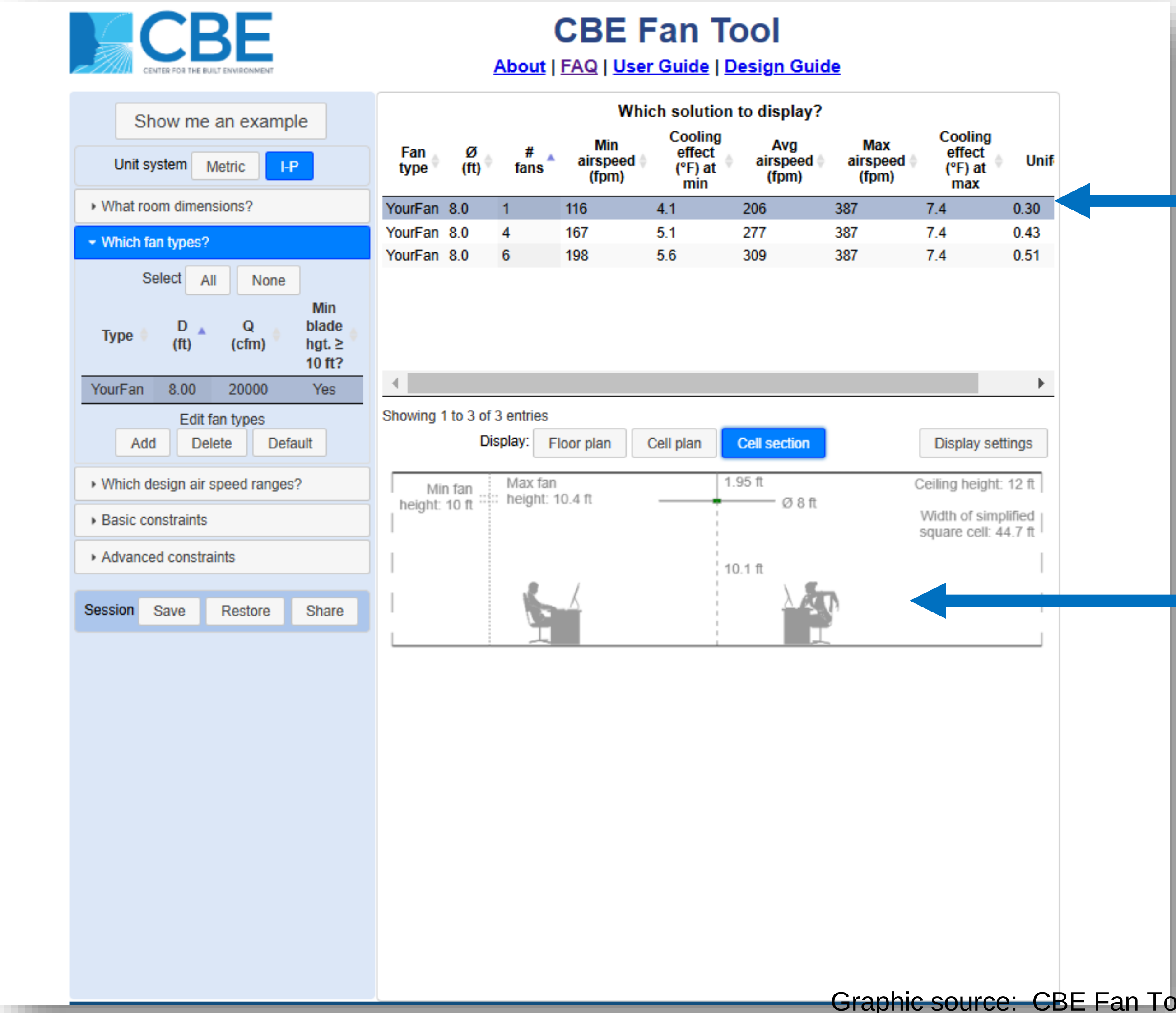
Make note of the cooling effect at min. and max. air flow.

Fan–space geometry

Online Ceiling Fan Tool: Case Study 7 *continued*

Case Study 7

Using a ceiling fan simulator, the practitioner can create environments that are perceived to be cooler through increased convective flow across the body (cooling effect)…this effect can be ramped up, if necessary, by lowering the dry bulb temperature and if necessary, the humidity.



Single fan solution

Make note of the cooling effect at min. and max. air flow.

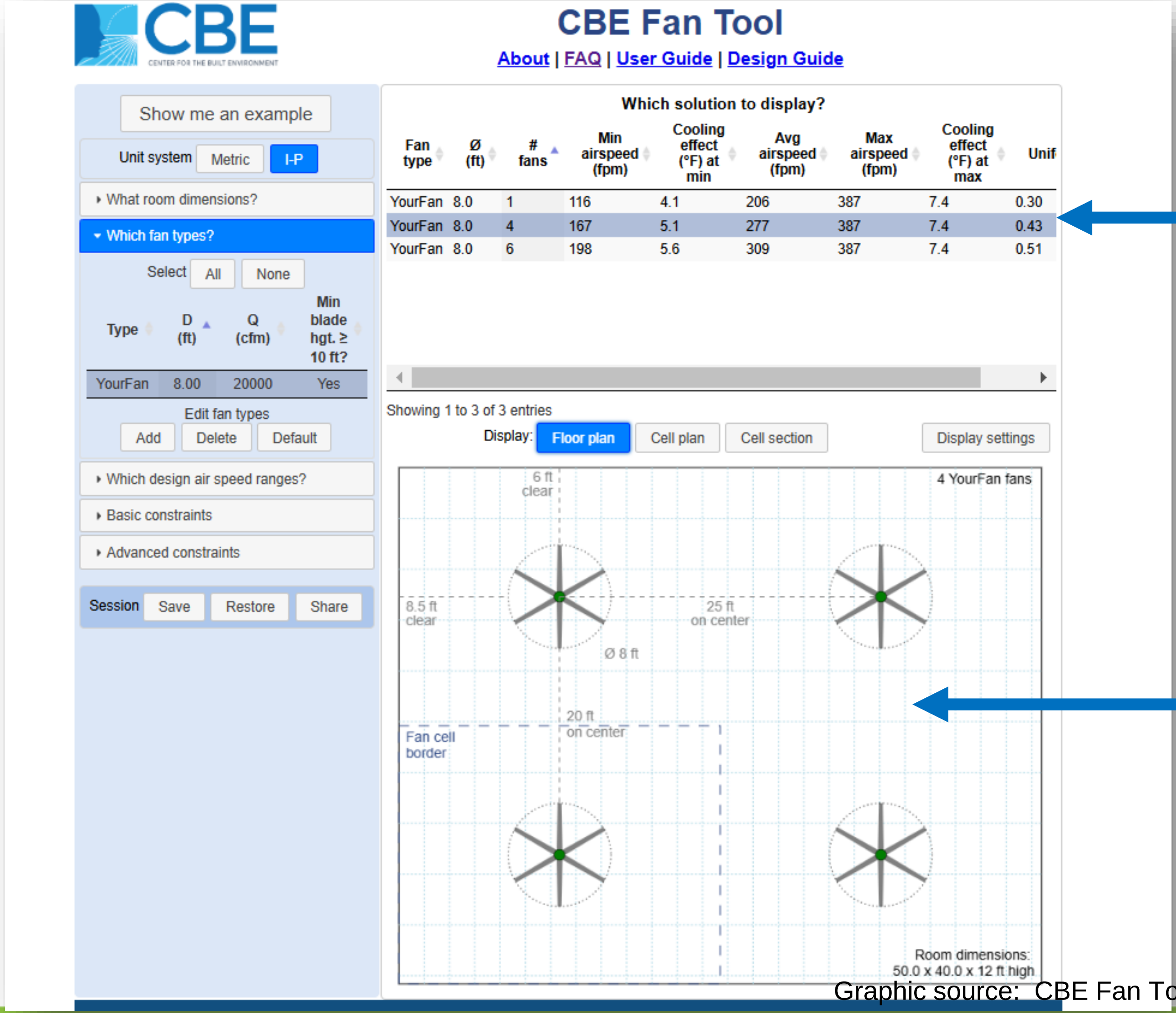
The sectional view of fan-space geometry.

Graphic source: CBE Fan Tool, Hosted by Center for the Built Environment

Online Ceiling Fan Tool:Case Study 8

Case Study 8

Using a ceiling fan simulator, the practitioner can create environments that are perceived to be cooler through increased convective flow across the body (cooling effect)…this effect can be ramped up, if necessary, by lowering the dry bulb temperature and if necessary, the humidity.



Quad fan solution

Make note of the cooling effect at min. and max. air flow.

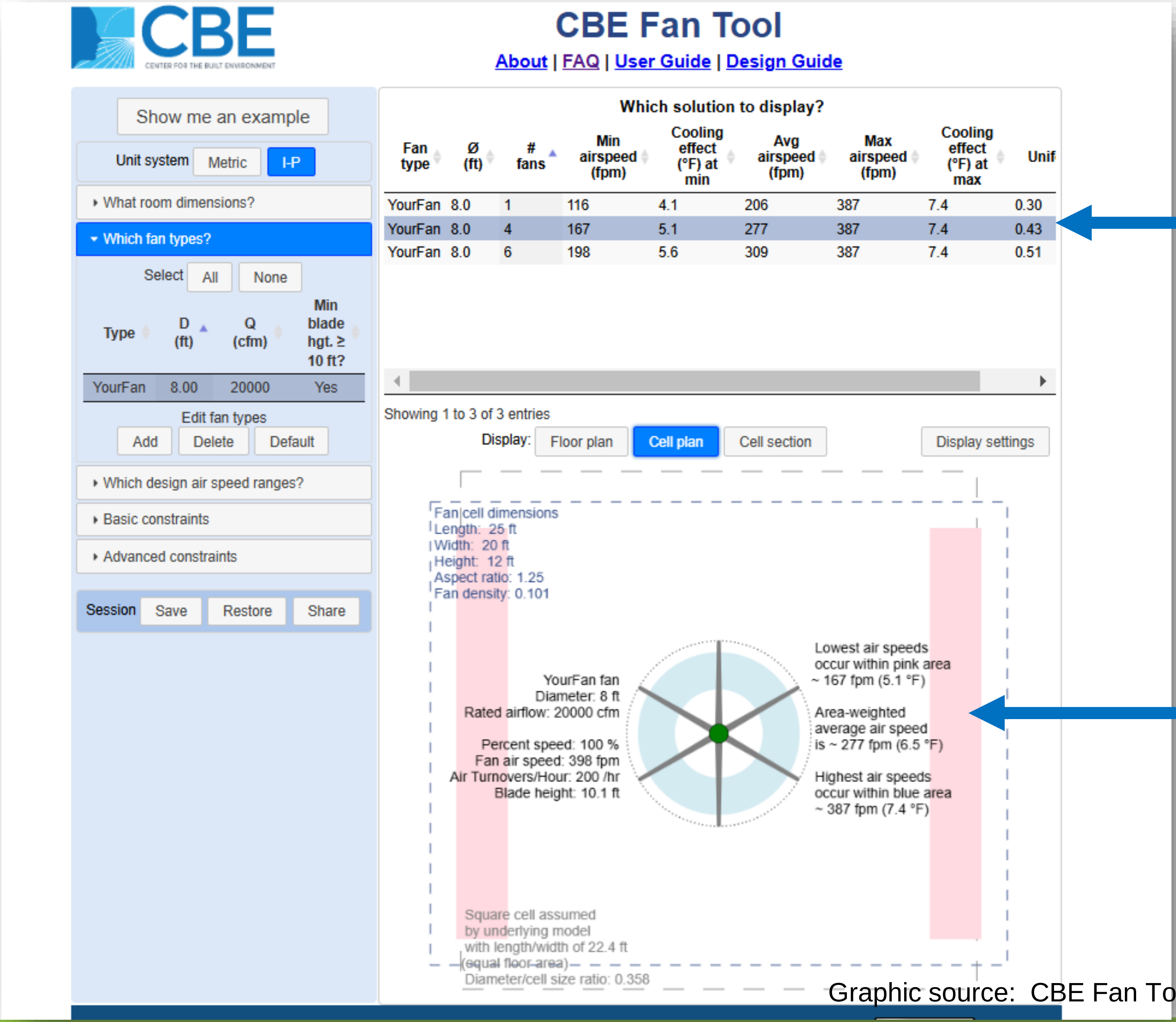
Fan–space geometry

Graphic source: CBE Fan Tool, Hosted by Center for the Built Environment

Online Ceiling Fan Tool: Case Study 8 *continued*

Case Study 8

Using a ceiling fan simulator, the practitioner can create environments that are perceived to be cooler through increased convective flow across the body (cooling effect)…this effect can be ramped up, if necessary, by lowering the dry bulb temperature and if necessary, the humidity.



Quad fan solution

Make note of the cooling effect at min. and max. air flow.

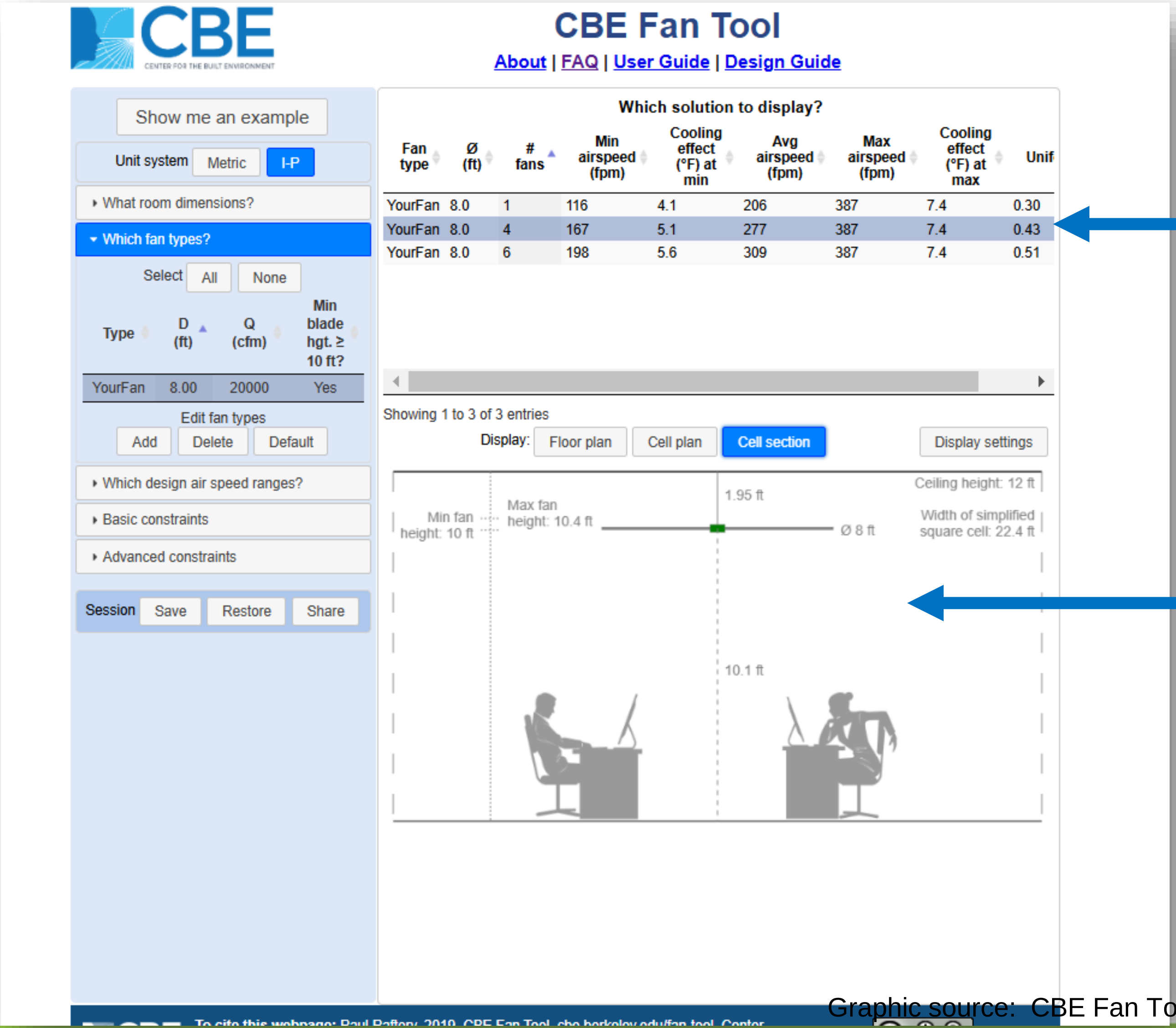
Make note of the cooling effect zones per quadrant.

Graphic source: CBE Fan Tool, Hosted by Center for the Built Environment

Online Ceiling Fan Tool: Case Study 8 *continued*

Case Study 8

Using a ceiling fan simulator, the practitioner can create environments that are perceived to be cooler through increased convective flow across the body (cooling effect)…this effect can be ramped up, if necessary, by lowering the dry bulb temperature and if necessary, the humidity.



Quad fan solution

Make note of the cooling effect at min. and max. air flow.

The sectional view/quad of fan-space geometry.

Graphic source: CBE Fan Tool, Hosted by Center for the Built Environment