CalBEM
California Building Energy Modeling

CBECC-Com Modeling Toolkit
Radiant Heating & Cooling

Frequently asked questions about CBECC-Com modeling for California's 2019 Building Energy Efficiency Standards, Title 24, Part 6.

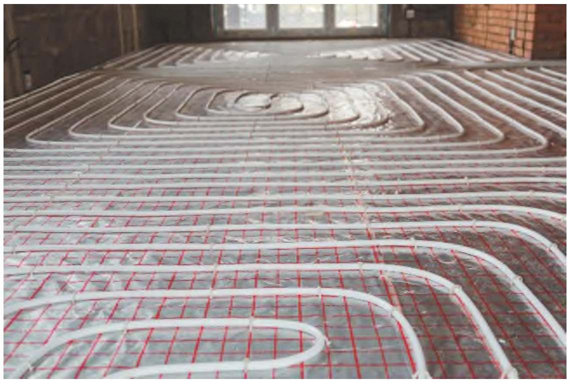


Image credits: Left: istockphoto.com, photo ID:620701016, Vladdeep Right: Carrier.com, Chilled Beam with Active Induction

Q: How can radiant heating and cooling systems be modeled?

Radiant Floor (or Embedded Wall) Systems

- Effective way to provide heating and comfort for some buildings and spaces
- Can be used as the primary heating or cooling system
- Requires a dedicated outside air source, such as a DOAS system

Active and Passive Chilled Beams

- Can model passive chilled beams or active beams with higher induced airflows
- Also requires a separate dedicated outside air system for the space
- Separate ventilation system typically handles latent loads from interior sources or from ventilation
- Chilled water temperature should be kept high enough to prevent condensation

Active versus Passive Chilled Beams

Both types of chilled beams can be modeled in CBECC-Com. Passive chilled beams are cooling-only devices that use natural convection from panels chilled by cooled, circulated water to condition the space. Active chilled beams can include connections for both chilled water and hot water and combine a constant source of primary air (ventilation) with additional air that is induced through the diffuser through room air. This allows the active chilled beam to provide a much higher cooling capacity than the passive one.

Compliance Credit for Radiant Heating and Cooling

The Title 24 performance compliance approach provides a significant potential credit for passive and active radiant cooling and heating systems. These systems are compared against a conventional forced air baseline system. Systems that separate the ventilation loads from heating and cooling loads can save a large amount of fan energy, since the air needed for ventilation is only a fraction of the air needed to actively heat and cool spaces. The systems can also run efficiently with the supply of a higher chilled water temperature than conventional systems. Care should be taken by the designer to address latent loads and to specify sufficient perimeter heating to ensure thermal comfort.

CalBEM (California Building Energy Modeling) is an industry collective and an annual statewide event hosted by Southern California Edison on behalf of the California Investor-Owned Utilities. Participants are invited as representative voices in the field of energy modeling.

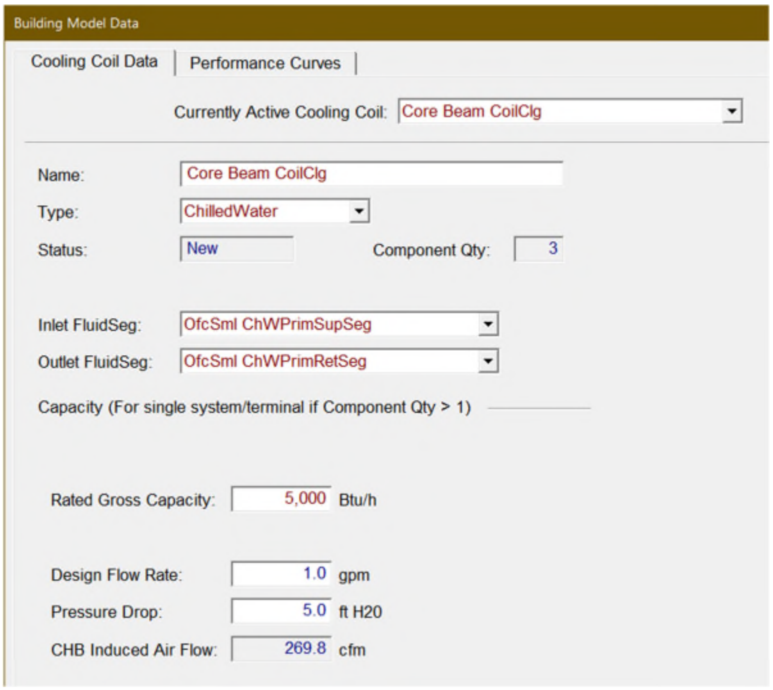
2021.05.26

Chilled Beams

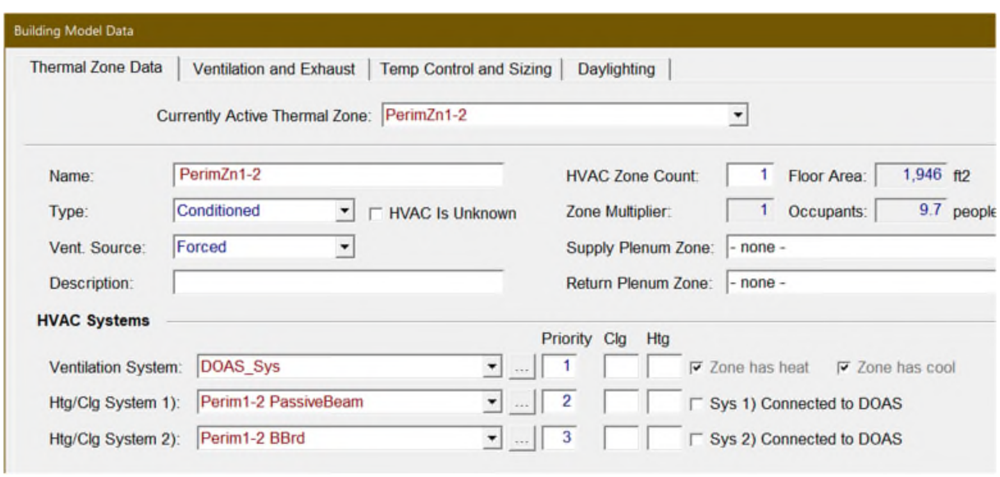
Modeling Passive Chilled Beams

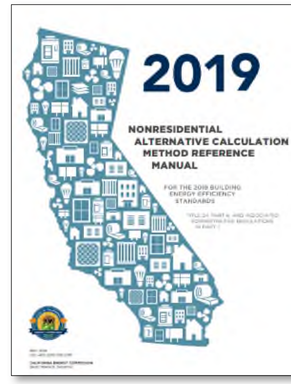
Passive chilled beams provide direct radiant cooling to a space using natural convection. They are normally paired with a ventilation system and a separate heating source, such as perimeter baseboards. The steps to define a passive system in CBECC-Com are shown below along with screen shots from the software:

1) Define the passive beam system with the design supply air temperature (typically 55F to 62F).
2) Define the chilled beam cooling coil, with chilled water as the cooling source, the cooling capacity, design flow rate and pressure drop.



3) Define the perimeter baseboard or other separate heating system.
4) Define the zone control. The ventilation system is the “priority 1” zonal system, followed by the passive chilled beam, and finally, the baseboard perimeter heating system.





2019 Nonresidential Alternative Calculation Method Reference Manual

Find the Manual here: energy.ca.gov/2019publications/CEC-400-2019-006/CEC-400-2019-006-CMF.pdf

Additional Resources:

CalBEM: calbem.ibpsa.us/

CBECC-Com: bees.archenergy.com/

Energy Code Hotline:

1-800-772-3300 (Free) or Title24@energy.ca.gov

CEC Online Resource Center: energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/online-resource-center

2019 NR Compliance Manual:

energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2019-building-energy-efficiency-1

Energy Code Ace: energycodeace.com

Modeling Active Chilled Beams

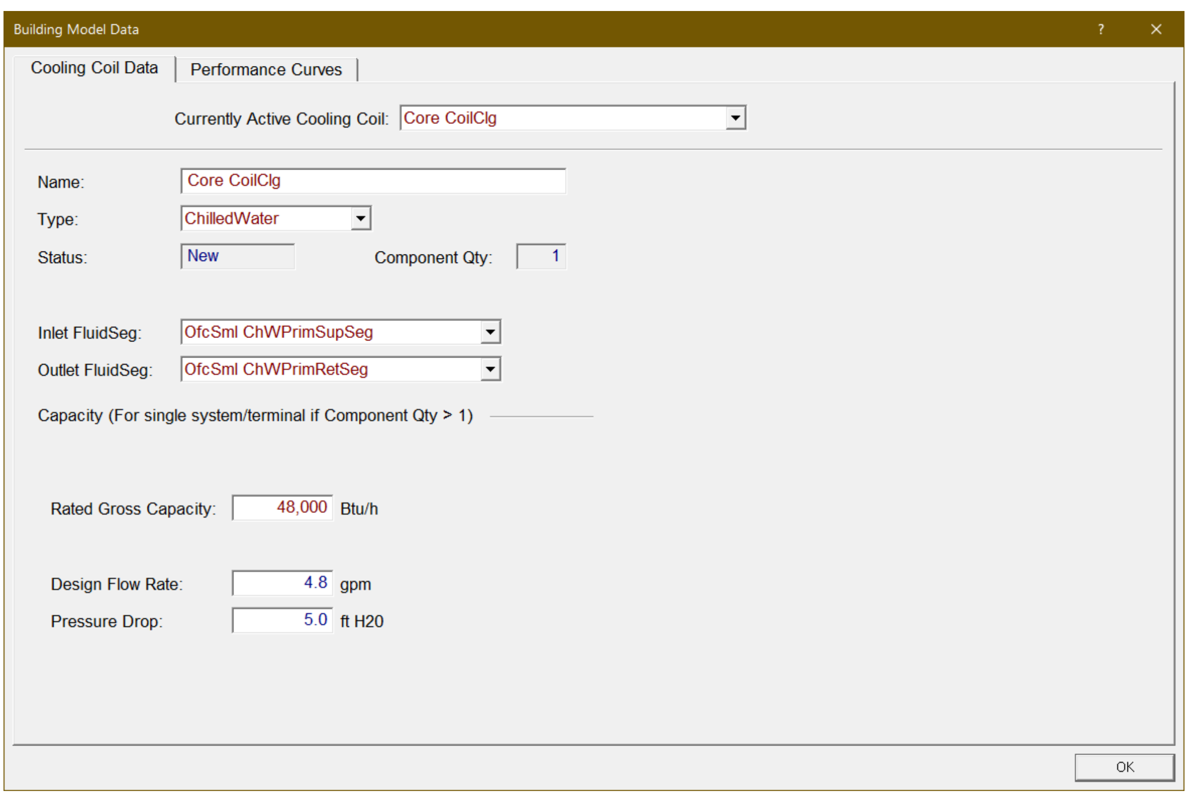
Active beams are very similar to passive beams, except that they have a means of inducing airflow through the beam with a small fan, increasing cooling capacity. Unlike passive beams, they are also suitable for heating. They are modeled in the same way as passive beams except the active flow rate across the coil is entered.

Radiant Heating (Embedded) Systems

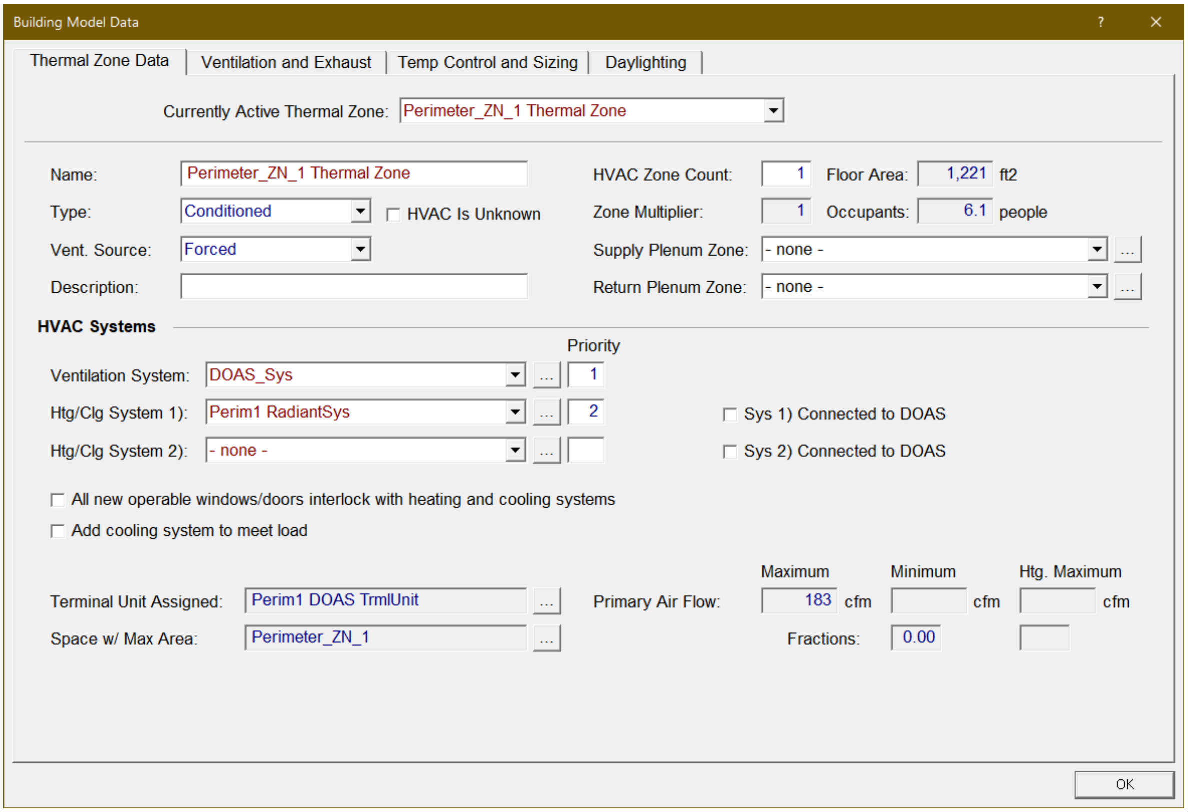
Radiant heating and cooling systems may be embedded in floors or ceilings. An example is a radiant floor system with a network of polyethylene (PEX) tubes embedded in the floor. These systems can provide heating, cooling, or both. At the zone definition level, the following inputs are required, with the selection or values in *Italics*:

- Type: *Radiant* defines the system as a radiant space conditioning system. A separate ventilation system is required.
- Sub Type: *Embedded* identifies the radiant system as embedded in the building envelope, as opposed to a chilled beam system, which can be pendant mounted.
- Change Over Time: for systems that provide both heating and cooling, this is a delay period before switching over from heating to cooling or vice versa. This may be needed for control stability. A typical value is in the range of 0.5 hours.
- A dedicated outside air system (DOAS) is a common option for ventilation. The DOAS system should be controlled to maintain neutral supply air temperatures, in the range of 60F-70F, while the heating and cooling systems control the space temperature to the setpoint.

The next step is to define the radiant “cooling coil” and “heating coil” used with the system (see below screen shot from the software). This specification identifies the source of chilled water and hot water, the cooling and heating capacity, and the flow rate through the radiant tubing. The pressure drop across the coil is also specified. Each of these parameters are taken from manufacturer’s performance data.



Finally, the thermal zone definition must link to the user-defined systems that provide heating and cooling. With an embedded radiant system, the radiant system serves as the heating and/or cooling system, while a separate ventilation system provides ventilation to the zone. Commonly, a dedicated outside air system (DOAS) provides tempered ventilation air directly to the zone(s). The following CBECC-Com screen shot shows an example.



As with chilled beam radiant systems, embedded radiant floor heating systems will use only a small fraction of the fan energy of forced air systems in the baseline, so there is a large potential compliance credit.