Example 1: MF Ventilation Options and Split Heat Pumps

SYSTEM TAG: MF-CEXH_ISUP-SZHP

PROJECT VISION

California Title 24 compliance modeling requires translating mechanical system designs into CBECC 2025 software objects, a process for which little practical guidance exists. Developed as part of the *Addressing Complex HVAC Systems in Code Compliance* project, funded by Southern California Edison through the CalBEM working group, each example walks through how a recognizable HVAC system type translates into CBECC objects, what Title 24 2025 Part 6 requires, and what assumptions were made.

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Example 1: MF Ventilation Options and Split Heat Pumps

Local Supply, Central Exhaust

System Tag: MF-CEXH_ISUP-SZHP

Mechanical Description

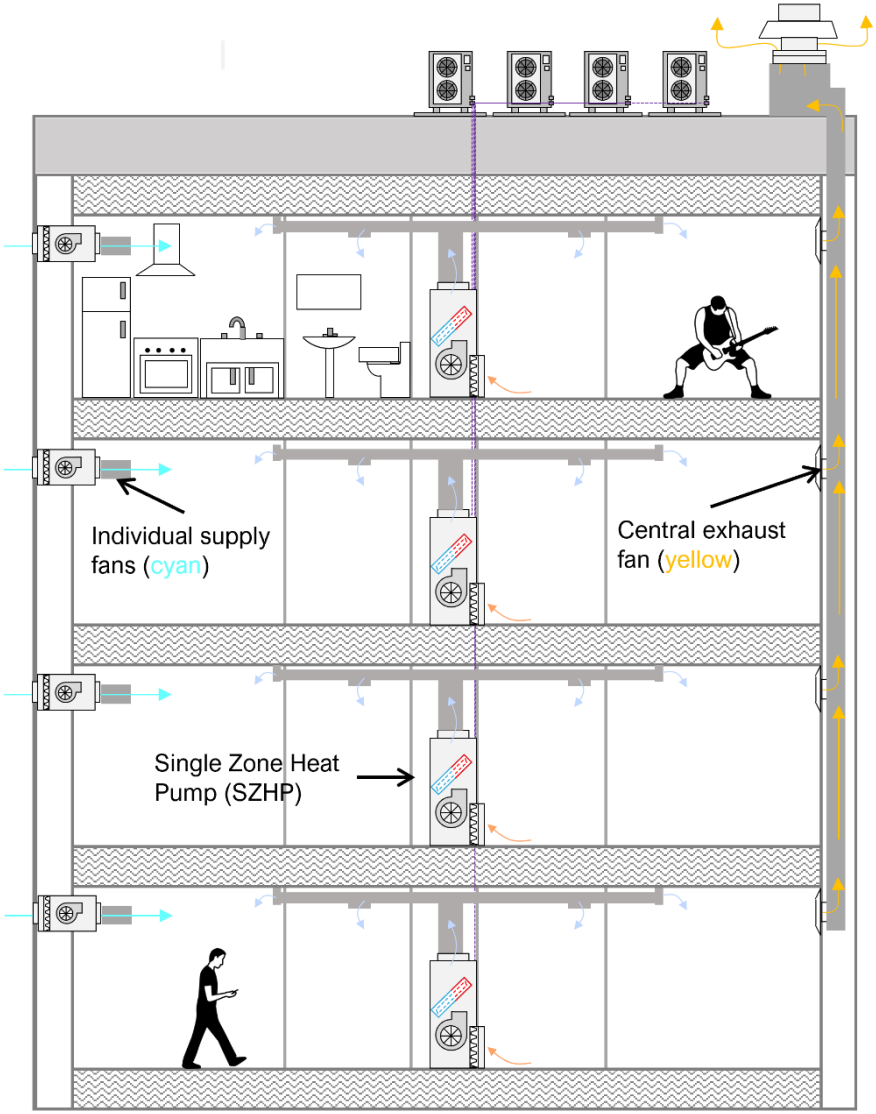
This multi-family model provides an example of ventilation configuration options in the compliance software. The option depicts one configuration here, referred to as option 1a, with additional alternate configurations in the additional example portion of this report for options 1b through 1e.

In this multi-family building, each residential dwelling unit is ventilated by an active supply fan and exhausted by a shared single exhaust fan system. The dwelling units are each conditioned by a dedicated ducted split heat pump, providing both heating and cooling. Heat pumps include electric resistance backup heat with no gas usage.

Domestic hot water is provided by a central heat pump water heater plant located in the first-floor mechanical room, with six outdoor-air-source compressors feeding a 750-gallon storage tank and a recirculation loop serving all units (not shown in diagram).

Diagram

The diagram shows a sample of four residential floors, each with an individual supply fan unit (left, cyan arrows) pushing outdoor air into the dwelling units, a central ducted split heat pump per floor serving the corridor zone, and a building-wide central exhaust riser (right, yellow arrows) collecting exhaust air to the roof. Outdoor condensing units are grouped on the rooftop.



Mechanical Details

Ventilation: Individual supply fan per dwelling unit; building-wide central exhaust

Ventilation control: Fixed flow, no DCV

Cooling: DX cooling via heat pump, all-electric

Heating: Heat pump primary; electric resistance backup (no gas)

Capacity control: Constant volume, fixed supply air temperature

Economizing: None on residential/common units; Fixed Dry Bulb on retail PVAV

Ventilation is handled entirely separately from the heat pump systems through an Individual Supply / Central Exhaust (ISUP/CEXH) strategy. Each unit has a small, dedicated supply fan that draws outdoor air directly into the unit; sized by bedroom count, from 31.2 cfm for studios to 72.3 cfm for three-bedroom units.

A single building-wide central exhaust fan collects stale air from all units and expels it at the roof. Supply and exhaust airflows are balanced at approximately 4,050 cfm total. Because ventilation is driven independently by these fans, the heat pump unit fan only runs when the thermostat calls for heating or cooling, reducing fan energy during mild weather conditions.

All heat pumps share the same rated cooling and heating efficiencies, set in the equipment table below. The model uses code-minimum federal SEER2, EER2, and HSPF2 to demonstrate baseline compliance behavior. Electric resistance backup is provided at each unit; there is no gas heating in the residential portion.

Mechanical Capacities and Sizing

Residential systems are autosized per dwelling unit by the simulation engine. This was done to streamline the HVAC configuration example. The capacity range shown reflects variation in zone exposure and floor level; all units share identical input efficiency ratings.

Residential Ventilation Fans

Unit Type	OA (cfm)	Supply W/cfm
Studio	31.2	0.35
1-Bed	36.6	0.35
2-Bed	54.9	0.35
3-Bed	72.3	0.35

Central exhaust fan: 0.302 W/cfm. Supply fans are supply-only type.

Residential Dwelling Units

Residential dwelling unit split heat pumps were set to code minimum efficiencies for heating, cooling, and the backup electric heating device.

Unit Type	Area (sf)	Autosized Cap. kBtu (range) *	COP	SEER2	EER2	HSPF2	Backup
Studio	540	6.3 – 10.7	3.4	14.3	11.7	7.5	Elec Res.
1-Bed	720	5.5 – 39.0	3.4	14.3	11.7	7.5	Elec Res.
2-Bed	1,080	10.6 – 31.6	3.4	14.3	11.7	7.5	Elec Res.
3-Bed	1,410	14.4 – 22.3	3.4	14.3	11.7	7.5	Elec Res.

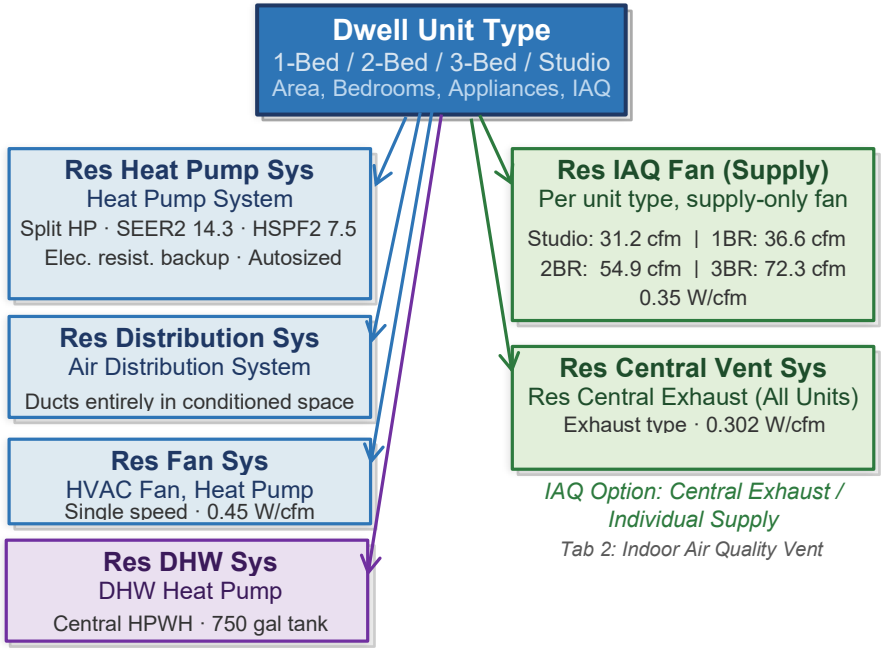
Code Compliance Software Configuration

In CBECC, the residential building is configured differently from the nonresidential side. Rather than a single air system object that owns its components, each dwelling unit type is defined as a DwellUnitType, a hub object that holds references to separately defined equipment objects. This means one heat pump system specification is shared across all 88 units.

The diagram below shows how the DwellUnitType assembles its components. The left branch (blue) covers HVAC conditioning and is configured on the Dwelling Unit Type Data tab. The right branch (green) covers ventilation and is configured on the Indoor Air Quality Vent tab.

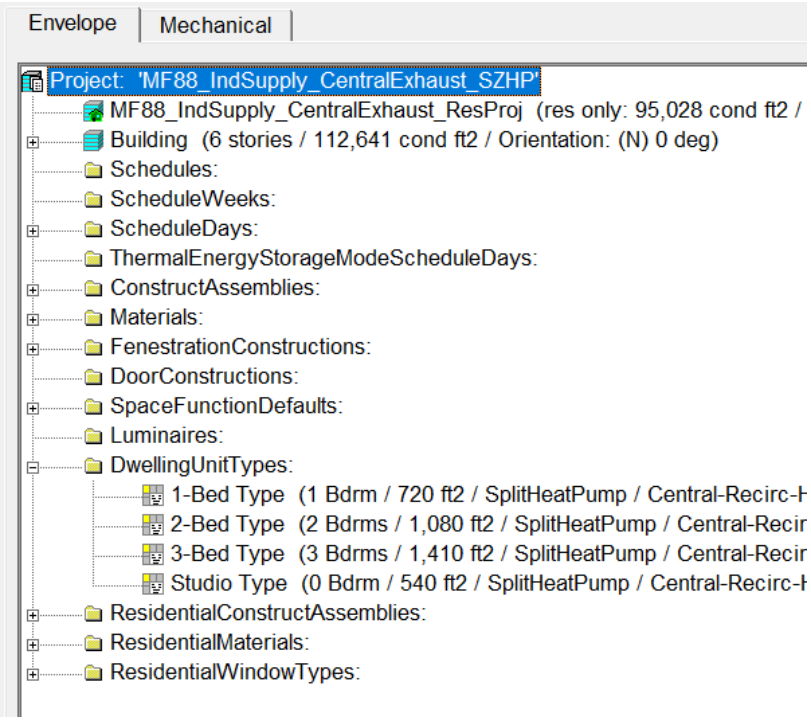
Key Modeling Points

- **The DwellUnitType is a template**, it defines equipment assignments once. Individual DwellUnit instances (52 thermal zones) reference a type and inherit all assignments.
- **The Heat Pump System object** is shared across all unit types. SEER2, EER2, and HSPF2 are set once and apply to every unit; capacity is autosized per zone.
- **The IAQ approach** is set per unit type on Tab 2: Central Exhaust / Individual Supply. Each type references its own supply fan (sized by bedroom count) and a shared central exhaust system.
- **The supply IAQ fans** are set to IAQ Fan Type = Supply and do not have the option for heat recovery.
- **The central exhaust system** (Res Central Exhaust, All Units) is a single building-wide object referenced by every unit type - not duplicated per unit or floor.

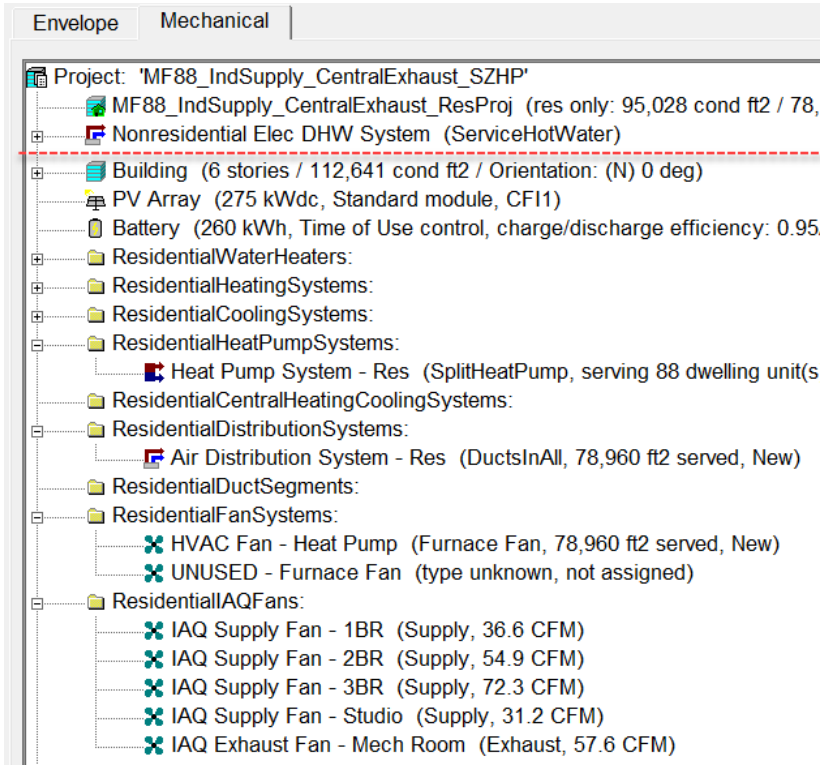


CBECC Object Locations

For multifamily buildings in CBECC the key objects for configuring the HVAC are on the envelope and the mechanical tab. The envelope tab as shown below is where dwelling units live. These are the integration points for all multifamily dwellings where all the components for each dwelling type are defined and linked to mechanical systems.

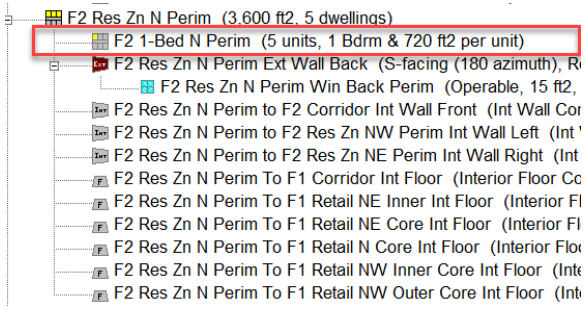


The mechanical tab is where those systems reside and where you can make multiple versions as needed of each system component. For example, this model uses a single heat pump system to represent the split heat pumps however you may end up with several of these one for each capacity of heat pump on a project. Similar you can see in the residential AQ fans there are multiple fans at specific air flow rates for fresh air based on the different number of bedrooms in each typical dwelling unit.



Thermal Space Dwelling Unit Data

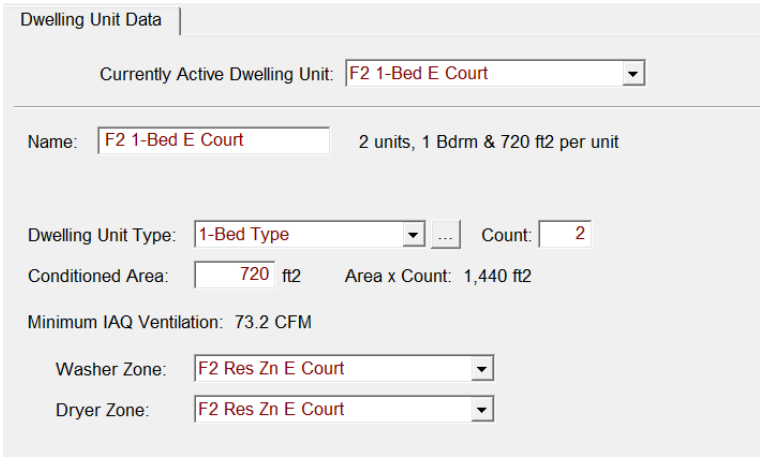
Each space in the model includes a Dwelling Unit Data object. This object holds how many instances of this type are included. In this example, the space has 2 1-Bed Type units included. It is also where the washer and dryer are defined.

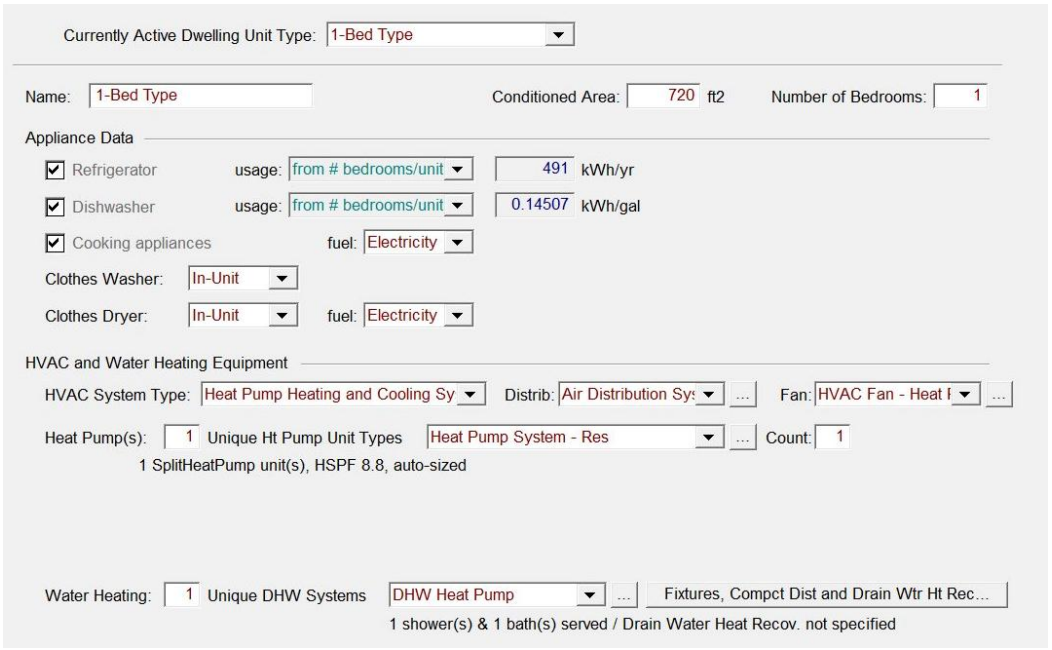


Dwelling Unit Type Data (1-Bed Type shown)

The DwellUnitType is a template, it defines equipment assignments once. Individual DwellUnit instances (52 thermal zones) reference a type and inherit all assignments.

This screen sets the DwellUnit area, bedroom count, appliances, HVAC system type, heat pump object, fan, distribution, and DHW reference

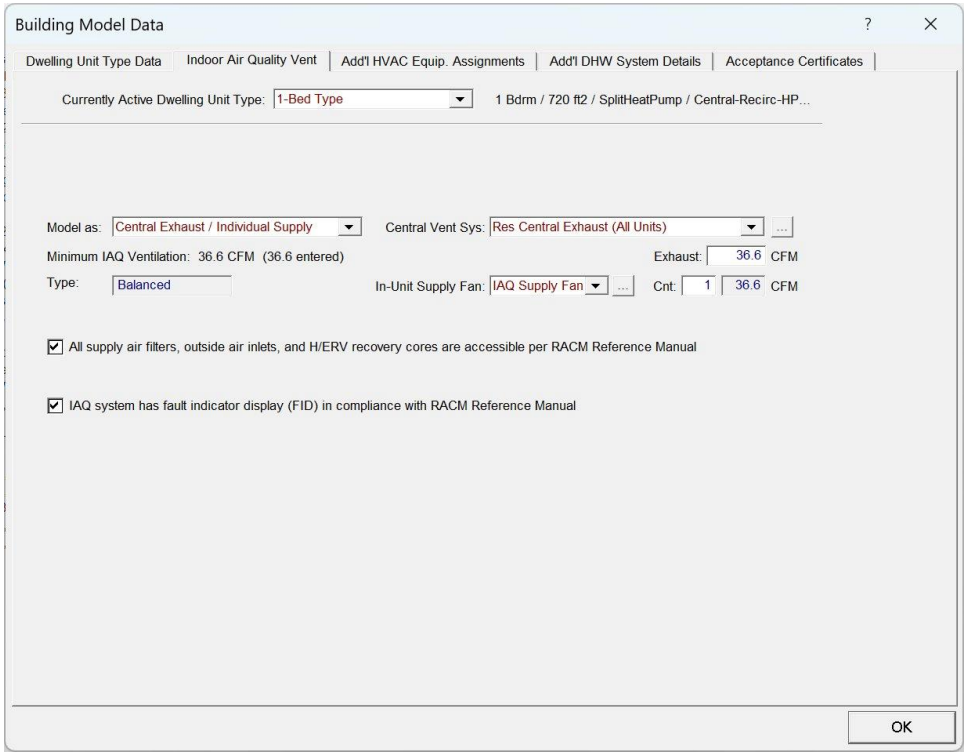




Indoor Air Quality Vent (1-Bed Type shown)

The IAQ approach is set per unit type on Tab 2: Central Exhaust / Individual Supply. Each type references its own supply fan (sized by bedroom count) and a shared central exhaust system.

Sets ventilation approach (Central Exhaust / Individual Supply), central vent exhaust system, in-unit supply fan, and accessibility/FID compliance checkboxes



Relevant Energy Code Citations

Restructured 2025 Title 24, Part 6 with section numbers shown with legacy cross-reference in brackets.

Ventilation & IAQ, Attached Dwelling Units

403.2.2.3 & 403.2.2.3.4 [160.2(b)2 & 160.2(b)2Aiv]:

The governing sections for MF dwelling unit ventilation. All attached dwelling units shall meet ASHRAE 62.2 as amended by the Code. ISUP/CEXH qualifies as balanced ventilation per item 2.1. Compartmentalization testing ≤ 0.30 cfm/sf at 50 Pa required per item 2.2.

Ducts in Conditioned Space

402.2.6.1.1, under 402.2.6.1 [150.0(m)1]:

When all ducts are located entirely within conditioned space, duct insulation is not required. Must be confirmed through HERS field verification per RA3.1.4.3.8. All dwelling unit ducts modeled as entirely in conditioned space. No duct loss penalty applied. HERS verification required at construction.

Single-Zone Ducted System Fan Efficacy

402.2.6.13.2 [150.0(m)13B]:

Single-zone ducted systems shall meet ≤ 0.58 W/cfm (non-gas AHU) at ≥ 350 cfm/ton airflow. Model inputs 0.45 W/cfm for all dwelling unit HVAC fans. HERS verification required.

HP Supplemental Heat Controls & Thermostat

402.2.2.7 & 402.2.4.2 [150.0(h)7 & 150.0(i)2]:

Heat pumps with electric resistance backup must lock out supplemental heat above 35°F OAT. Thermostats must display when backup is active, include OAT sensing, and meet setback requirements.

Electric Resistance Supplemental Heat Sizing

402.2.2.8 [150.0(h)8]:

The capacity of electric resistance supplemental heat shall not exceed the HP nominal cooling capacity (at 95°F) × 2.7 kW/ton, rounded up to nearest kW. CBECC autosizes the backup element. Model uses a 0.75× heating sizing factor for the HP compressor, with backup covering the remaining load.

Standard Design Mechanical Package, CZ9

403.3.1.1 [170.2(c)3A]:

For MF performance compliance in CZ9: HP SEER2 and HSPF2 at federal code minimum per 403.3.1.1; refrigerant charge verification required per 403.3.1.2.1; HRV/ERV not required for balanced ventilation. Individual supply fan efficacy for non-HRV supply systems: 0.40 W/cfm per 403.3.1.2.5 in CZ 5-10 and CZ 15.

Standard design uses same SZHP system type as proposed. Primary compliance margin comes from fan energy and lighting, not equipment efficiency.

This example is one of eight developed as part of the *Addressing Complex HVAC Systems in Code Compliance* project. The full guide includes additional HVAC system types, alternative configurations, and working CBECC model files. All resources are available through the CalBEM working group and EnergyCodeAce platform.