Integrating Dedicated Dehumidification Systems in Passive House Design: A Crucial Component for Optimal Indoor Air Quality

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• What is a Dehumidifier?
• How does a Dehumidifier work?
• Should I, Could I, Would I?
• Quick Hitters
A whole house ventilating dehumidifier is designed to work with the home’s HVAC system to:

- Bring in outdoor ventilation air
- Filter the air (MERV 13)
- Dehumidify the air in the entire home to maintain a set relative humidity (RH) level.
Dehumidifier

How a Dehumidifier works

Evaporator: Cools water vapor into droplets that fall into the tank.
Condenser: Warms cooled air to room temperature.
Fan: Draws air in and pushes air out of dehumidifier.

Damp Air

Compressor: Compresses gasses in evaporator coils to cool them and expands gasses in condenser coils to warm them.

Dry Air

Water Tank

Its an Air Conditioner in a box!
Definitions and Terminology

**Sensible Load** is the temperature you feel on your body and measured with a thermometer. This is controlled with the HVAC thermostat.

**Latent Load** is the moisture in the air often referred to as relative humidity. This is more challenging to control with the HVAC thermostat.
Passive Houses: Low-Sensible Load Homes

<table>
<thead>
<tr>
<th>Continuous Insulation</th>
<th>Sensible Cooling Load</th>
<th>Latent Cooling Load</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>↓</td>
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<tr>
<td>Air Tight Construction</td>
<td>↓</td>
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<tr>
<td>Optimized Windows/Shading</td>
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<td>Mechanical Ventilation</td>
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<td>Ducts in Conditioned Space</td>
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Credit – Lisa White
Other Factors That Can Lead to High Humidity

- Construction drying
- Lots of wood - other porous materials
- Seasonal Temperature Swings
- Daily Temperature Swings
- High SEER AC equipment with a high SHF
- High dew points outside
- People generating moisture
- People operating the system and the house according to their lifestyle
Passive Houses Have More Internal Moisture

Humid Partial Load Annual Frequency

Credit: Kimberly Llewellyn
Air Conditioning

- Designed to reach a temperature set-point (sensible)
- New units have dehumidification set-points – still cooling

Typical residential HVAC systems need 14 minutes of run time to begin effective dehumidification.
The SEER rating of a unit is the cooling output during a typical cooling season divided by the total electric energy input during the same period. The higher the unit's SEER rating, the more energy efficient it is.

### High SEER AC

- Larger coils that are very efficient at getting to a cool temp quickly means less run time. **Typical coil holds 1 pint of water per ton**
- Coils do not get as cold as older AC systems. **Less water removed from air and going down the drain**
- High efficiency A/C runs 1-3 minute fan delays at end of cycle to increase SEER rating. **Increases the SEER rating by .5**
- Can increase indoor RH by up to 10%
The dehumidification effectiveness of air conditioning equipment

\[
\text{SHF} = \frac{\text{Sensible Cooling Load}}{\text{Total Cooling Load}}
\]
# SEER vs SHF

<table>
<thead>
<tr>
<th>Rated Cooling Capacity (Btu/h) [95F]</th>
<th>SEER</th>
<th>Sensible Heat Factor</th>
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<tbody>
<tr>
<td>18000</td>
<td>20.5</td>
<td>0.87</td>
</tr>
<tr>
<td>22400</td>
<td>20.5</td>
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<td>0.96</td>
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<tr>
<td>9000</td>
<td>30.5</td>
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<tr>
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</tr>
<tr>
<td>12000</td>
<td>26.1</td>
<td>0.83</td>
</tr>
</tbody>
</table>

**SEER & SHF**

**Water Removal**
1. **Could I** use a dehu if I don't have forced air or ERV ductwork systems?

2. **Should I** Connect an ERV and Dehumidifier?

3. **Could I** install a Dehumidifier on the return side?

4. **Should I** install a Dehumidifier on the supply side?
No Forced Air or ERV Ductwork
Connect ERV and Dehumidifier

Don’t have traditional forced air systems?

• Ductless mini-split

• Heating and Cooling with high static duct systems

• Radiant cooling systems
1. Dehumidifier fan must run with ERV is ON

2. Motorized damper is required to prevent dehumidifier from drawing air when ERV is off

3. Higher operating cost
Option 2: Share Supply Ducts

1. Backdraft damper required to prevent ERV supply from entering dehu return

2. Commissioning: Ductwork static pressure changes if commissioned with dehu on or off
   - May affect flow rate
   - May create slight positive or negative pressure on the house when dehu runs
The Standard

1. Best performance
2. Highest cost
HVAC Return to HVAC Return

Check Damper should be in place between the Return and Supply connections of the dehumidifier.

If Check Damper is not in place, the HVAC fan must turn on when the dehumidifier is in operation.
Final Report

Investigation of Energy Impacts of Ducted Dehumidifier Duct Configurations and Location

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A Research Institute of the University of Central Florida
Supply-To-Supply

- Air Handler
- HVAC Supply
- Optional Outdoor Air Intake
- Motorized Damper
- Santa-Fe Return
- Santa-Fe Supply
- Optional Check Damper (no HVAC fan needed)
Quick Hitters!!

• Don’t install dehumidifiers over a bedroom

• Don't install thermostat/humidistat in pathway of supply air

• Install it close to a crawl door for easier maintenance

• Two forced air systems and one dehumidifier
Don’t forget the backdraft damper
Sufficient P-Trap
Why Homes Need Dedicated Dehumidification

- Comfort, Health & Property Protection
- Partial & No-Load Times of the Year
- Can’t Control Human Behavior
- Only Way to Ensure 50% RH
Thank you!

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