CRF UNDERSTANDING CONDENSATION

What is condensation?

Condensation occurs when water vapor (humidity) is converted to liquid water when the air temperature suddenly decreases at a surface. Condensation can appear as water or frost on that surface depending on the surface's temperature.

Building Improvements = More Condensation

Buildings have increased their energy efficiency with better insulated envelopes causing less air exchanges between the interior and exterior environments. This is especially true during uncomfortable outdoor temperatures, when operable windows and doors remain closed. Any humidity produced within a building, like shower steam or water vapor from plants, becomes trapped and increases the relative humidity.

There are even times where installing high efficiency windows may create a condensation problem that did not exist before their addition. This is due to the windows increased air sealing capabilities. The older windows may have allowed the humid air to escape through small openings in the window unit. The installation of the high efficiency windows locks the humidity in the house and doesn't allow it to escape through the cracks, creating visible condensation.

On the other side of that situation there is times where with identical windows only one may condensate. This may be due to having a heat source right below the window, or differences in the air circulation near the window itself or install process.

Common Surfaces that Cause Condensation

During the winter, surfaces that are the most likely to conduct heat to the outside are the first that will form condensation. These surfaces usually show condensation in the following order:

1. Windows & other glazed surfaces
2. Doors
3. Poorly insulated walls and ceilings.

Some areas are prone to year-round condensation because their functions create water vapor. These areas include: bathrooms, kitchens, and laundry rooms. Shower steam will rapidly condense on windows, skylights, and bathroom hardware. In the winter, this condensation will be greater because the same shower steam at the same temperature and relative humidity levels contacts the same surfaces that are usually colder than in the summer.

In addition, houses built on crawl spaces or lacking an adequate vapor barrier from the earth can experience higher humidity originating from the evaporating moisture of the soil. Components like door sills that directly contact masonry foundation that is not properly insulated may lose heat to the earth and are more likely to form condensation.

Relative Humidity

There are three variables that determine condensation: exterior temperature, interior temperature, and interior relative humidity. The exterior temperature cannot be controlled and the interior temperature is determined by comfort. Therefore, the relative humidity level is the variable that needs to be managed in most situations. The American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) recommend an interior range of relative humidity between 25-60% for health and comfort, although the lower end of the range is based on comfort alone. However, an interior temperature maintained at 65°F with 50% relative humidity will develop condensation on a window when its surface drops to 45°F. Meanwhile, that same interior temperature with 25% relative humidity won't develop condensation until the window surface drops to 28°F. Therefore, colder exterior temperatures require lower relative humidity levels inside for the same interior temperature.

After understanding the causes of condensation, monitor the above listed common surfaces that exhibit condensation at the different times of the year. This is important because moisture can lead to mold and mildew problems. It can also cause water damage to wood, insulation, or electrical systems.

Manage Condensation on Windows & Doors

- Identify sources of water vapor and try to reduce or eliminate the vapor. Exhaust fans in the bathroom, kitchen, laundry room, or plant growing areas can greatly reduce interior humidity. An adequate vapor barrier between the earth and the structure may need to be installed.
- Dehumidifiers can greatly assist by lowering the interior humidity.
- Discontinue the use of humidifiers, which may have been recommended for use during the winter.
- Monitor windows and doors. Better performing windows may be needed if they are poorly insulated and allow air infiltration. Windows and doors that are covered by blinds or shades should be uncovered at least 4 inches during the day if condensation occurs.
- Try to keep recessed windows in the building design to a minimum. This can create small pockets of air that do not exchange as frequently as flush mounted windows.
- Increase air circulation by fans to prevent heat and humidity pockets.

Recommended Interior Humidity for Varying Outside Temperatures

OUTSIDE TEMPERATURE	INSIDE HUMIDITY
-18˚	Not over 15%
-17˚ to -9˚	Not over 20%
-8˚ to -2˚	Not over 30%
-1˚ to 10˚	Not over 35%
11˚ to 21˚	Not over 35%
22˚ to 40˚	Not over 40%