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CONDENSATION IN HIGH-PERFORMANCE HOMES

Part 1: An Architect & Builder Field Guide

Diagnosis, Risk Mitigation, and Expectation Alignment

Purpose of This Guide

Condensation is one of the most frequently misdiagnosed conditions in residential construction—and one of the most disruptive when misunderstood.

This guide is intended to support architects, builders, and project teams with a clear, systematic framework for diagnosing condensation correctly, aligning systems early, and managing risk before it manifests on site or after occupancy.

Condensation is rarely a product failure. It is almost always an environmental imbalance.

First Principle: Condensation Is a Signal, Not a Defect

Condensation indicates that temperature, humidity, airflow, and envelope behavior are out of alignment. Windows and glass do not create condensation; they reveal it—because they are the most thermally exposed surfaces in the building.

Replacing windows does not correct the underlying condition unless a sealed unit has failed.

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Step 1: Identify the Moisture Condition

Determine where moisture is occurring before proceeding.

- Interior glass surface › Environmental condition
- Exterior glass surface › Normal under specific climatic conditions
- Between panes › Sealed unit failure (glass issue)

Only the third condition warrants glass replacement.

Step 2: Confirm Interior Relative Humidity (Measured, Not Assumed)

- Measure actual interior RH
- Compare RH to exterior temperature and dew point
- Review humidification systems and seasonal settings
- Confirm winter RH targets align with building performance

Key Insight: High-performance homes often require lower winter RH than occupants expect. This is a comfort conversation, not a defect discussion.

Step 3: Evaluate Ventilation and HVAC Strategy

- Mechanical ventilation present (HRV / ERV / induced air)?
- System balanced, commissioned, and operational?
- Exhaust loads (kitchens, baths, spas, pools) properly managed?
- HVAC setpoints extreme or inconsistent?

Airtight buildings do not self-regulate moisture. Ventilation must be intentional.

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Step 4: Assess Airtightness and Interior Airflow

- Blower-door test completed?
- Stagnant air zones near large glazed assemblies?
- Conditioned air washing glass surfaces?
- Furnishings or detailing restricting airflow?

Condensation frequently forms where air is still, not where performance is weakest.

Step 5: Review Glass and Coating Strategy

- Glazing configuration confirmed (double / triple)?
- Low-E coating locations identified?
- Glass performance aligned with HVAC strategy?
- Specification responds to climate, not code minimums?

Higher-performance glass can shift condensation behavior, not eliminate it.

Step 6: Confirm Thermal Separation at Frames and Interfaces

- Fully thermally broken systems specified?
- Thermal breaks continuous through corners and junctions?
- Frame material appropriate for exposure and climate?
- Performance expectations aligned with material realities?

Step 7: Inspect Installation Continuity

- Insulation continuous at openings?
- Thermal bridges controlled at structure-to-frame interfaces?
- Air and vapor barriers properly integrated?
- Installation executed as detailed?

Continuity failures often masquerade as product problems.

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Step 8: Consider Orientation and Environmental Exposure

- Elevations most affected identified?
- Solar exposure and shading reviewed?
- Rapid diurnal temperature swings accounted for?
- Proximity to water bodies or coastal conditions considered?

Step 9: Align Expectations Early

- Seasonal condensation behavior discussed with client?
- Occupants educated on HVAC operation?
- Condensation framed as environmental feedback—not failure?
- Envelope consultant engaged where risk is elevated?

Final Diagnostic Rule

If condensation resolves through humidity control, airflow correction, or system adjustment, it was never a fenestration failure.

Windows do not cause condensation.
They expose imbalance.

Use this guide early.

Condensation addressed at design stage is inexpensive.
Condensation addressed after occupancy is not.