Detailing Measures for Moisture Management in Energy Efficient Homes

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Neil P. Leslie, P.E.
Gas Technology Institute
847 768 0926
neil.leslie@gastechnology.org

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Outline

> Project Description
> Demonstration Homes Approach
> Innovative Assemblies Demonstration Homes
> Conclusions and Recommendations
Project Description

> Objectives

– Evaluate detailing measures for moisture management in residential applications in seven production homes in northern California and southern California
– Identify construction issues, potential cost savings, and builder benefits from implementing detailing measures

> Approach

– Provide input to builder plans and specifications
– Support demonstration home construction
– Install and monitor data acquisition systems
– Analyze and document results
Demonstration Homes Participants

> Two Production Home Builders
  – Energy Star Homes
  – Zero Energy Homes

> Seventeen Product Manufacturers
  – Window and wall assemblies
  – Concrete slab
  – Interior treatments
  – Controls
Energy Star Demonstration Homes

> Six Energy Star Production Homes, Chino, CA
  - Two ACI 302.1R-04 slab homes, two baseline homes
  - Four detailing measure demonstration homes

> Data Acquisition Systems
  - In situ RH sensors in all 4 concrete slab homes
  - Moisture pins, temperature, relative humidity in 4 wall cavities in one detailing measure home
Zero Energy Demonstration Home

> Zero Energy Production Home, Watsonville, CA
  - 1 detailing measure demonstration home
  - Joist construction on concrete pier foundation, no slab

> Data Acquisition System
  - Moisture pins, temperature, relative humidity in 4 wall cavities
Detailing Measures

> WRB Options and Construction Sequence
> Self-Adhering Flashing Options
> Window Installation Methods
> Mold-Resistant Sealer
> Mold-Resistant Interior Gypsum Panels
> Construction Drying Services
> Bath Ventilation Control And Noise Reduction
Weep Screed Installation, Lot No. 77
Housewrap Application, Lot No. 76
Housewrap Application, Lot No. 78
Housewrap Flashing Below Vent
ASTM E 2112-01R Method A1, Lot No. 76
Sill Flashing with ¾” Backer Rod Backdam, Lot No. 78
Flashing Installation, Lot No. 79

a) Corner Shield and Self-Adhering Sill Flashing

b) Mechanically Fastened and Self-Adhering Sill and Jamb Flashing
Window Installation, Lot No. 79
ASTM E2112-07 Sill Pan Flashing Drainage Path

- Backer Rod Under Sill Flashing to Contain Window Leak
- Foam Sealant
- Vinyl Window Frame
- Vinyl Window Flange (No Caulk)
- Self-Adhering Flexible Sill Flashing
- Housewrap
- Shiplapped Single Ply Building Paper
- Drainage Path with Frame Leak
- Three-Coat Stucco Cladding
- Metal Lath
- Capillary Break
- Concrete Slab
- WD-40® Bond Break
- Weep Screed
ASTM E2112-01 Sill Flashing
Drainage Path

- Vinyl Window Frame
- Vinyl Window Sill Flange
- Caulk Blocks Drainage Behind Sill Flange
- Mechanically Fastened Sill Flashing
- Shiplapped Two Ply Building Paper
- Drainage Path
- Three-Coat Stucco Cladding
- Metal Lath
- Drainage at Weep Screed Dominated by Capillary Flow
- Weep Screed
- OSB Sheathing
- Sill
- Capillary Break
- Base Plate
- Concrete Slab
- Leak to Interior with Window Frame Leak
- Drainage at Weep Screed Dominated by Capillary Flow
Mold-Resistant Sealer in 2nd Floor Bath, Lot No. 76
Gypsum Panels 2\textsuperscript{nd} Floor Bath, Lot No. 76
Continuous Duty Exhaust Fan and Timer Control, Lot No. 77
Flashing Installed Before Housewraps, Lot No. 76-78
Housewrap Integrated with Vent Flashing, Lot No. 76
Flashing Installed After Housewrap, Lot No. 76-78
Building Paper Integrated with Flashing, Baseline Construction
Roof Flashing Incorrectly Installed After Housewrap
Flashing for Recessed Window, Lot No. 76
Flashing for Recessed Window, Baseline Construction
Housewrap Application with Open Frame
Flanged Vinyl Backdam Stapled to Sill
Self-Adhering Flexible Sill Flashing
Reduced Sill Reveal with Backdam
Leveling Tool Compatible with Flexible Sill Flashing
Wall Cavity Moisture Content Measurements

Wood Moisture Content (%) vs. Date

- Dates: 12/13/05, 3/23/06, 7/1/06, 9/06, 1/17/07, 4/27/07
- Wood moisture content ranges from 8.0% to 16.0%
Wall Cavity Relative Humidity Measurements

![Graph showing relative humidity measurements over time from 12/13/05 to 4/27/07.](image-url)
Detailing Measures 
Observations

> Construction Sequence Evaluated for Housewrap Demonstration Homes Rarely Used in California Home Construction with Stucco Cladding
  - Preferred by manufacturer and building scientists for optimum air barrier and WRB performance
  - Risk of reverse shingle-laps at penetrations
  - Trade coordination and education for construction sequence modifications
  - Incremental labor content
  - Risk of leaks at taped butt joints (e.g., holes, tears, v-cut for head flashing) and increased number of staple holes

> Builder and Contractors Prefer Two-Ply Building Paper for Stucco
Detailing Measures Observations (Cont’d)

> Application of Other Options Went Smoothly
  – Consideration for future implementation will be based on perceived cost/benefit

> Limited Moisture Content Data Indicate Good Moisture Control

> Builder planning on implementing several options
  – Self-adhering flashing
  – Sill pans under windows
  – Concrete slab seats under doors
  – Low noise energy efficient bath exhaust fan/lights
  – Mold resistant sealer on selected OSB and Studs
  – Quality inspection service
Detailing Measures
Conclusions

> Demonstration Met Goals
  – Provided data on theoretical benefits and real-world application of innovative detailing measures
  – Reinforced market value of current high quality practices
  – Increased awareness of building science issues and impacts on mold risk
  – Identified issues with stucco WRB installation sequence when striving for theoretically optimal performance

> Research Recommendations
  – Continue monitoring, expand field demonstrations
  – Collect comprehensive field data on WRB performance
  – Develop appropriate consensus standards