U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

BUILDING TECHNOLOGIES PROGRAM

Performance Evaluation and Opportunity Assessment for St. Bernard Project

Bruce Dickson
IBACOS, Inc.

June 2011

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U.S. Department of Energy

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Technical Report: Performance Evaluation and Opportunity Assessment for St. Bernard Project

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Introductions and Observations

The St. Bernard Project is a nonprofit, community-based organization whose mission is to assist Hurricane Katrina survivors return to their homes and communities in the New Orleans area. IBACOS, along with the National Renewable Energy Laboratory (NREL) and U.S. Department of Energy (DOE), is involved in consulting for the organization's Rebuilding Program.

IBACOS has been tasked with performing Building Energy Optimization (BEopt) modeling on two representative plans furnished by St. Bernard Project and recommending affordable measures to be adopted into the St. Bernard Project's retrofit process. To help homeowners and the parties involved understand the benefits of an investment in such improvements, IBACOS has conducted simple energy modeling to understand and visualize the energy savings associated with specific upgrades in comparison to St. Bernard Projects current practices.

In addition to the BEopt modeling, on January 25 and 26, 2011, IBACOS, along with representatives from the DOE, NREL, and St. Bernard Project, conducted an extensive field walk of several of St. Bernard Project homes in the New Orleans area that are currently being rebuilt. The purpose of this field walk was to observe and document current construction practices in terms of building durability, energy efficiency, occupant comfort, health and safety. Following the field walks, the IBACOS team reviewed the field data and identified the most critical areas to focus on in terms of energy efficiency improvements and preventing moisture related building durability issues.

The following pages in this report will first depict the energy modeling results of two plans that the St. Bernard Project put forth as "typical" building types. The remaining portion of the report includes pictures and descriptions of Quality Issues that were observed during the field walk and Best Practice recommendations to consider that will improve the energy efficiency and durability of the renovated homes.

Energy Modeling and Analysis

BEopt or Building Energy Optimization modeling. is a computer software program developed by the National Renewable Energy Laboratory that is designed to find optimal building designs along the path to highly efficient buildings. The models are based on evaluating the marginal costs of different combinations of energy efficiency options.

The BEopt analysis uses an efficient search technique to identify optimal and near optimal combinations of efficiency options. The sequential search approach used by the analysis method involves searching all construction categories (wall type, ceiling type, window glass, mechanical systems, etc.) for the most cost-effective combination of practices along the path to higher energy efficiency.

IBACOS has analyzed two designs with the BEopt modeling program that represent the typical house types existing within the St. Bernard Project's operation. The plans were taken from two specific houses: Creely Drive, and Mehle Street, St. Bernard Parish. These particular houses are single family, slab-on-grade, and typical for the region. In addition to the slab-on-grade models, an open pier foundation with a wood framed floor system was also modeled to account for as many common house types in the New Orleans area.

The first initial model analyzed the energy improvement characteristics that are being achieved through St. Bernard Project's current retrofit strategies. To perform this model, a pre-Katrina base case specification package was developed for comparison purposes. The base case specifications are estimated building components that would typically have been installed in a home before the Hurricane Katrina storm event. The base case building includes R-11 wall insulation, R-19 ceiling insulation, a very leaky building envelope (18.6 ACH/50), uninsulated and leaky ductwork located in the attic, single pane windows, electric furnace, standard water heater and appliances, and no fluorescent light fixtures. Houses are modeled as all-electric, due to limited availability of gas.

BEopt modeling showed that the current strategies that St. Bernard Project is implementing in their retrofit packages are achieving an improvement in energy savings between 10% to 13% over the base case house. These savings can mostly be attributed to an increased wall R-value, better air tightness, the use of ENERGY STAR® appliances, and better ductwork.

Further optimization modeling was then conducted on the two houses to identify possible strategies that would improve the percentage of savings against the current St. Bernard Project specification package. The building specifications packages recommended in this report have been defined, in part, through the use of BEopt version 1.0.1.

Figure 1 represents the results of the cost optimization analysis from BEopt, where the points along the curve represent the most cost-effective specification package of measures that achieve a given energy savings. For each plan type modeled, IBACOS identified four "upgrade" packages driven by this analysis. More information on these packages can be found later in this report. Cost information included in this report, derived from BEopt, represents national construction data and may not accurately reflect local construction labor and/ or materials pricing available to St. Bernard Project.

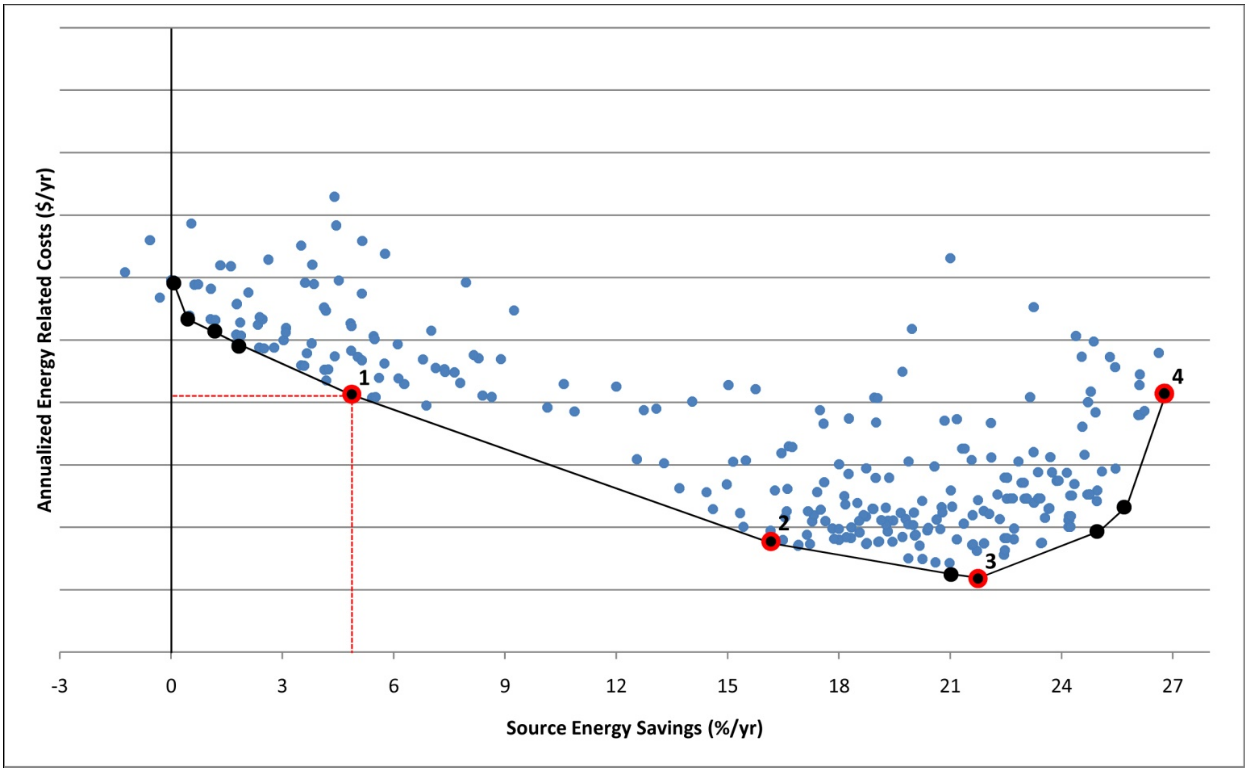

Figure 1. Cost Optimization Analysis from BEopt

The tables and graphs that follow represent recommended specification packages that should be considered to improve the overall energy performance of the typical St. Bernard Project's retrofit activities; each table is specific to the house type, foundation, and exterior cladding. Although both the Creely and Mehle plans are clad in brick, they were also modeled in an open pier configuration with vinyl cladding to give a representative example of a house with that type of foundation.

Figure 2. Creely Drive Photo

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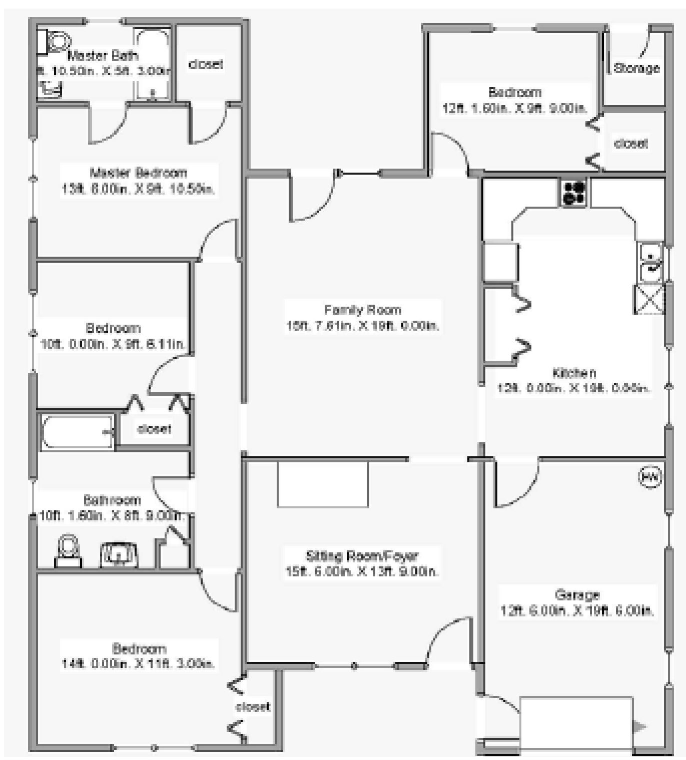

Figure 3. Creely Drive Floor Plan

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Table 1. Creely - Slab Foundation Base Specifications and Option Upgrade Packages

Single Story Slab-on-grade						
1684 sqft conditioned floor area, 164 sqft window area						
Category Name	Pre-Katrina Housing Spec.	St. Bernard Standard Spec.	Upgrade Option 1	Upgrade Option 2	Upgrade Option 3	Upgrade Option 4
Walls						
Wood Stud	R11 batts 2x4 16"o.c.	R13 batts 2x4 16"o.c.	R13 batts 2x4 16"o.c.	R13 batts 2x4 16"o.c.	R13 batts 2x4 16"o.c.	R15 batts 2x4 16"o.c. + 1" foam
Exterior Finish	Red Brick	Red Brick	Red Brick	Red Brick	Red Brick	Red Brick
Ceilings/Roofs						
Unfinished Attic	Ceiling R19 Fiberglass Batts Vented	Ceiling R19 Fiberglass Batts Vented	Ceiling R19 Fiberglass Batts Vented	Ceiling R19 Fiberglass Batts Vented	Ceiling R19 Fiberglass Batts Vented	Ceiling R38 Fiberglass Batts Vented
Radiant Barrier	None	None	None	None	None	None
Foundation/Floors						
Slab	None	None	None	None	None	None
Windows						
Window Type	Single Pane, U-0.869 SHGC-0.619	Double Clear, U-0.49 SHGC-0.65	Double Clear, U-0.49 SHGC-0.65	Double Clear, U-0.32 SHGC-0.3	Double Clear, U-0.32 SHGC-0.3	Double Clear, U-0.32 SHGC-0.3
Airflow						
Infiltration	18.6 ACH 50	14.5 ACH 50	10.3 ACH 50	3.7 ACH 50	3.7 ACH 50	3.7 ACH 50
Mechanical Ventilation	None	Exhaust 50% of A-62.2	Exhaust 50% of A-62.2	Exhaust 50% of A-62.2	Exhaust 50% of A-62.2	Exhaust 50% of A-62.2
Major Appliances						
Refrigerator	Standard Top Mount Freezer	Energy Star Side-by-Side Freezer	ENERGYSTAR Side-by-Side Freezer	ENERGYSTAR Side-by-Side Freezer	ENERGYSTAR Side-by-Side Freezer	ENERGYSTAR Side-by-Side Freezer
Cooking Range	Electric Conventional	Electric Conventional	Electric Conventional	Electric Conventional	Electric Conventional	Electric Conventional
Dishwasher	Standard	ENERGYSTAR	ENERGYSTAR	ENERGYSTAR	ENERGYSTAR	ENERGYSTAR
Clothes Washer	Standard	ENERGYSTAR	ENERGYSTAR	ENERGYSTAR	ENERGYSTAR	ENERGYSTAR
Clothes Dryer	Electric	Electric	Electric	Electric	Electric	Electric
Lighting						
Lighting	0% Fluorescent Hardwired	0% Fluorescent Hardwired	100% Fluorescent Hardwired	100% Fluorescent Hardwired	100% Fluorescent Hardwired	100% Fluorescent Hardwired
Space Conditioning						
Air Conditioner	None	SEER 13	SEER 13	SEER 13	None	None
Furnace	Electric	Electric	Electric	Electric	None	None
Heat Pump	None	None	None	None	SEER 13. HSPF 8.1	SEER 13. HSPF 8.1
Ducts	Leaky Uninsulated (Attic)	Typical R6 Insulation (Attic)	Typical R6 Insulation (Attic)	Typical R6 Insulation (Attic)	Typical R6 Insulation (Attic)	Typical R6 Insulation (Attic)
Water Heating						
Water Heater	Electric Standard, 92% EF	Electric Standard, 92% EF	Electric Standard, 92% EF	Electric Standard, 92% EF	Electric Standard, 92% EF	Electric Premium, 95% EF
Percent Improvement on St. Bernard Standard		0.0%	4.5%	9.7%	22.4%	30.7%
Percent Improvement on Pre-Katrina House		11.2%	15.2%	19.8%	31.1%	38.5%

Highlighted options are upgrades to observed St. Bernard Project specifications

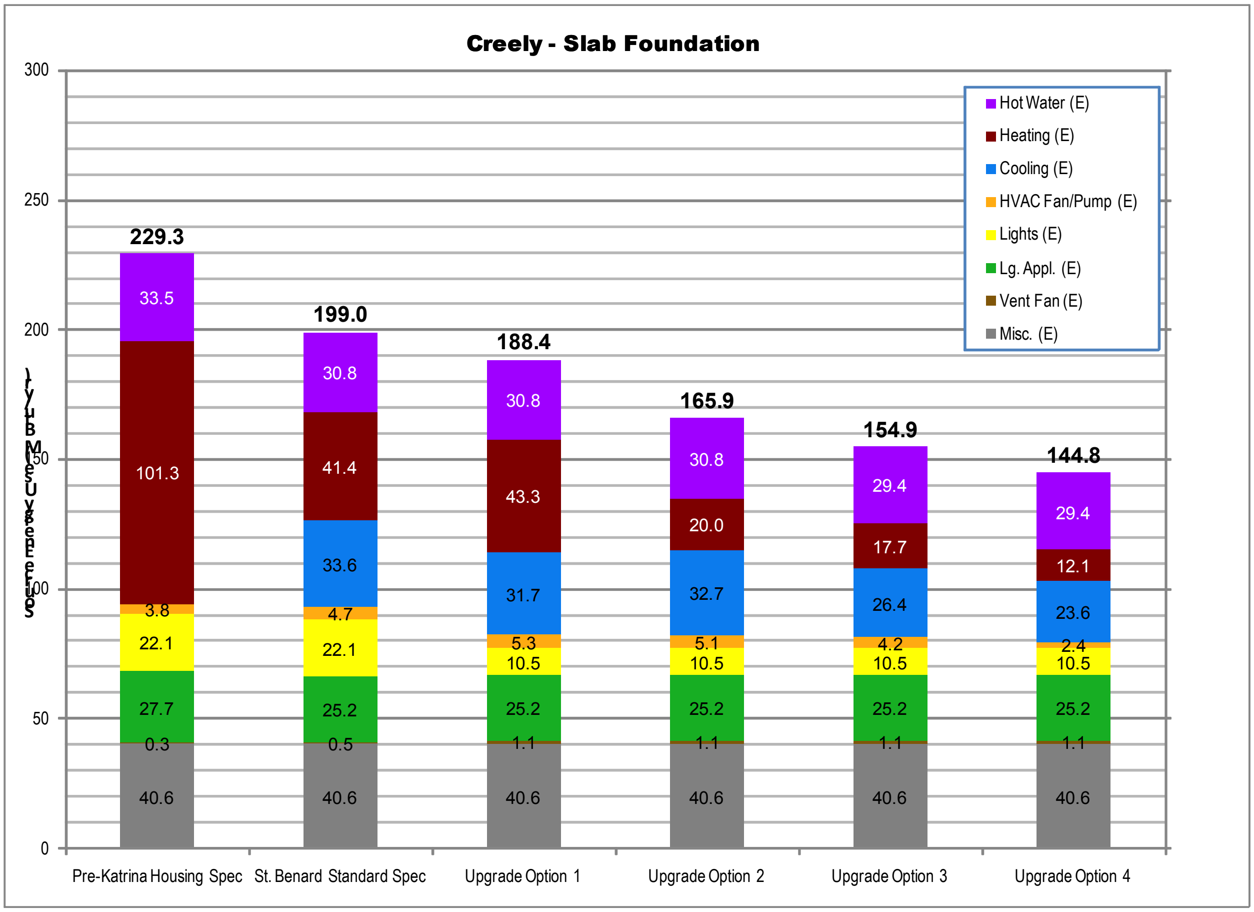

Figure 4. Creely – Slab Foundation Energy Modeling Results

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Table 2. Creely - Open Pier Foundation Base Specifications and Option Upgrade Packages

Vented Crawl or Open Pier Foundation						
1684 sqft conditioned floor area, 164 sqft window area						
Category Name	Pre-Katrina Housing Spec.	St. Bernard Standard Spec.	Upgrade Option 1	Upgrade Option 2	Upgrade Option 3	Upgrade Option 4
Walls						
Wood Stud	R11 batts 2x4 16"o.c.	R13 batts 2x4 16"o.c.	R13 batts 2x4 16"o.c.	R13 batts 2x4 16"o.c.	R13 batts 2x4 16"o.c.	R13 batts 2x4 16"o.c. + 1" foam
Exterior Finish	Gray Vinyl Siding	Gray Vinyl Siding	Gray Vinyl Siding	Gray Vinyl Siding	Gray Vinyl Siding	Gray Vinyl Siding
Ceilings/Roofs						
Unfinished Attic	Ceiling R19 Fiberglass Batts Vented	Ceiling R19 Fiberglass Batts Vented	Ceiling R19 Fiberglass Batts Vented	Ceiling R19 Fiberglass Batts Vented	Ceiling R19 Fiberglass Batts Vented	Ceiling R19 Fiberglass Batts Vented
Radiant Barrier	None	None	None	None	None	Yes
Foundation/Floors						
Crawlspace 4'	Uninsulated Vented	Uninsulated Vented	Uninsulated Vented	Uninsulated Vented	Uninsulated Vented	Ceiling R13 Vented
Windows						
Window Type	Single Pane, U-0.869 SHGC-0.619	Double Clear, U-0.49 SHGC-0.65	Double Clear, U-0.49 SHGC-0.65	Double Clear, U-0.32 SHGC-0.3	Double Clear, U-0.32 SHGC-0.3	Double Clear, U-0.32 SHGC-0.3
Airflow						
Infiltration	18.6 ACH 50	14.5 ACH 50	10.3 ACH 50	3.7 ACH 50	3.7 ACH 50	3.7 ACH 50
Mechanical Ventilation	None	Exhaust 50% of A-62.2	Exhaust 50% of A-62.2	Exhaust 50% of A-62.2	Exhaust 50% of A-62.2	Exhaust 50% of A-62.2
Major Appliances						
Refrigerator	Standard Top Mount Freezer	ENERGYSTAR Side-by-Side Freezer	ENERGYSTAR Side-by-Side Freezer	ENERGYSTAR Side-by-Side Freezer	ENERGYSTAR Side-by-Side Freezer	ENERGYSTAR Side-by-Side Freezer
Cooking Range	Electric Conventional	Electric Conventional	Electric Conventional	Electric Conventional	Electric Conventional	Electric Conventional
Dishwasher	Standard	ENERGYSTAR	ENERGYSTAR	ENERGYSTAR	ENERGYSTAR	ENERGYSTAR
Clothes Washer	Standard	ENERGYSTAR	ENERGYSTAR	ENERGYSTAR	ENERGYSTAR	ENERGYSTAR
Clothes Dryer	Electric	Electric	Electric	Electric	Electric	Electric
Lighting						
Lighting	0% Fluorescent Hardwired	0% Fluorescent Hardwired	100% Fluorescent Hardwired	100% Fluorescent Hardwired	100% Fluorescent Hardwired	100% Fluorescent Hardwired
Space Conditioning						
Air Conditioner	None	SEER 13	SEER 13	SEER 13	None	None
Furnace	Electric	Electric	Electric	Electric	None	None
Heat Pump	None	None	None	None	SEER 13. HSPF 8.1	SEER 13. HSPF 8.1
Ducts	Leaky Uninsulated (Attic)	Typical R6 Insulation (Attic)	Typical R6 Insulation (Attic)	Typical R6 Insulation (Attic)	Typical R6 Insulation (Attic)	Typical R6 Insulation (Attic)
Water Heating						
Water Heater	Electric Standard, 92% EF	Electric Standard, 92% EF	Electric Standard, 92% EF	Electric Standard, 92% EF	Electric Premium, 95% EF	Electric Premium, 95% EF
Percent Improvement on St. Bernard Standard		0.0%	4.4%	10.0%	23.6%	28.9%
Percent Improvement on Pre-Katrina House		11.4%	15.3%	25.8%	32.3%	36.9%

Highlighted options are upgrades to observed St. Bernard Project specifications

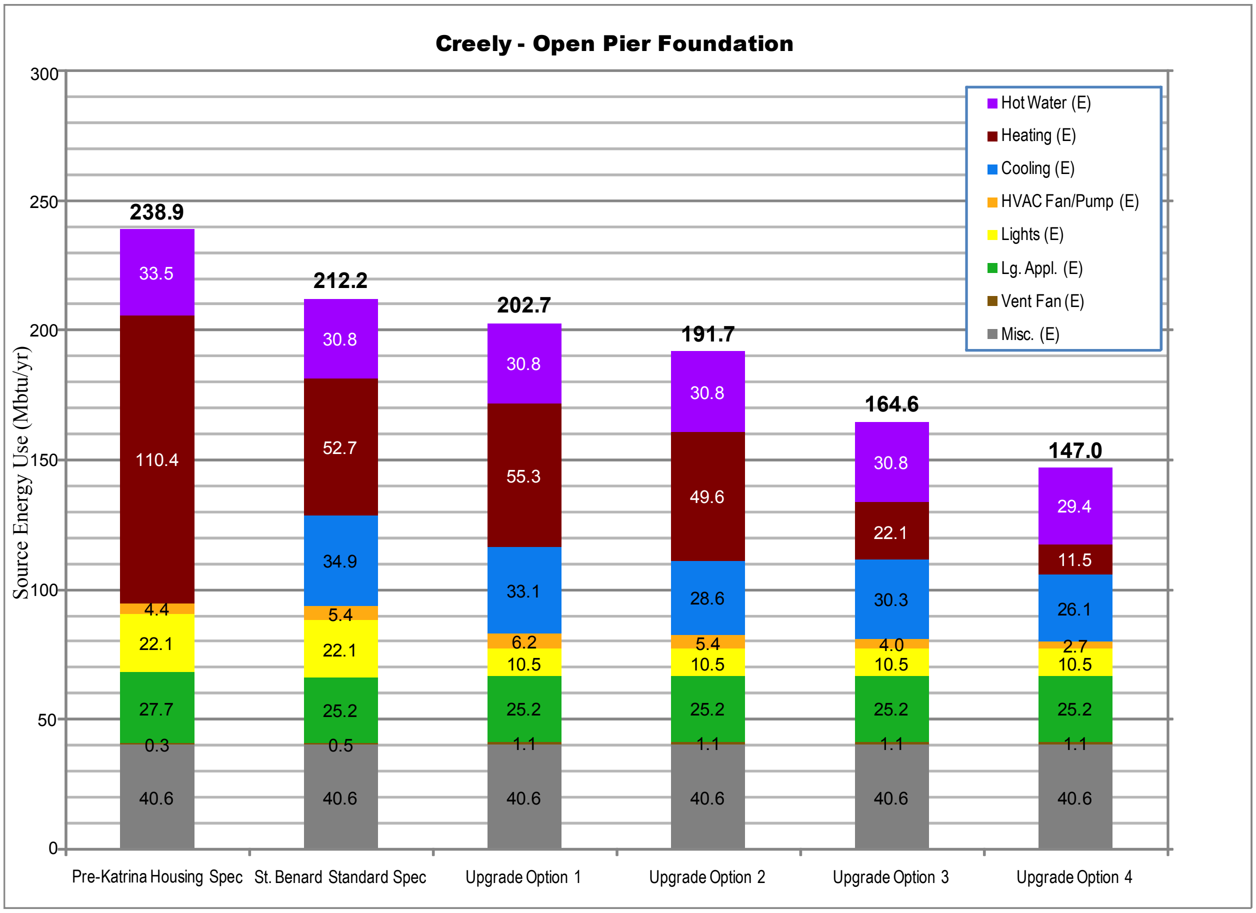

Figure 5. Creely – Open Pier Foundation Energy Modeling Results

Figure 6. Mehle Street Photo

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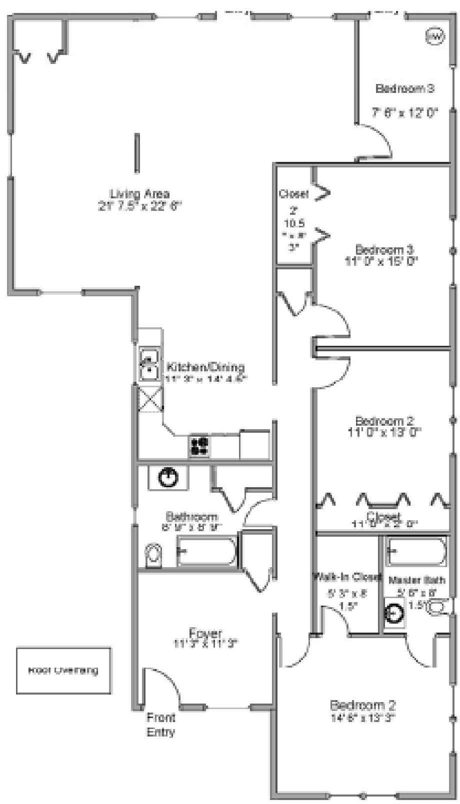

Figure 7. Mehle Street Floor Plan

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Table 3. Mehle - Slab Foundation Base Specifications and Option Upgrade Packages

Single Story Slab-on-grade						
1894 sqft conditioned floor area, 189 sqft window area						
Category Name	Pre-Katrina Housing Spec.	St. Bernard Standard Spec.	Upgrade Option 1	Upgrade Option 2	Upgrade Option 3	Upgrade Option 4
Walls						
Wood Stud	R11 batts 2x4 16"o.c.	R13 batts 2x4 16"o.c.	R13 batts 2x4 16"o.c.	R15 batts 2x4 16"o.c.	R13 batts 2x4 16"o.c.	R15 batts 2x4 16"o.c. + 1" foam
Exterior Finish	Light Brown Brick	Light Brown Brick	Light Brown Brick	Light Brown Brick	Light Brown Brick	Light Brown Brick
Ceilings/Roofs						
Unfinished Attic	Ceiling R19 Fiberglass Batts Vented	Ceiling R19 Fiberglass Batts Vented	Ceiling R19 Fiberglass Batts Vented	Ceiling R19 Fiberglass Batts Vented	Ceiling R19 Fiberglass Batts Vented	Roof R38 Fiberglass Batts Unvented
Radiant Barrier	None	None	None	None	None	None
Foundation/Floors						
Slab	None	None	None	None	None	None
Windows						
Window Type	Single Pane, U-0.869 SHGC-0.619	Double Clear, U-0.49 SHGC-0.65	Double Clear, U-0.49 SHGC-0.65	Double Clear, U-0.49 SHGC-0.65	Double Clear, U-0.49 SHGC-0.65	Double Clear, U-0.32 SHGC-0.3
Airflow						
Infiltration	18.6 ACH 50	14.5 ACH 50	10.3 ACH 50	3.7 ACH 50	3.7 ACH 50	3.7 ACH 50
Mechanical Ventilation	None	Exhaust 50% of A-62.2	Exhaust 50% of A-62.2	Exhaust 50% of A-62.2	Exhaust 50% of A-62.2	Exhaust 50% of A-62.2
Major Appliances						
Refrigerator	Standard Top Mount Freezer	ENERGYSTAR Side-by-Side Freezer	ENERGYSTAR Side-by-Side Freezer	ENERGYSTAR Side-by-Side Freezer	ENERGYSTAR Side-by-Side Freezer	ENERGYSTAR Side-by-Side Freezer
Cooking Range	Electric Conventional	Electric Conventional	Electric Conventional	Electric Conventional	Electric Conventional	Electric Conventional
Dishwasher	Standard	ENERGYSTAR	ENERGYSTAR	ENERGYSTAR	ENERGYSTAR	ENERGYSTAR
Clothes Washer	Standard	ENERGYSTAR	ENERGYSTAR	ENERGYSTAR	ENERGYSTAR	ENERGYSTAR
Clothes Dryer	Electric	Electric	Electric	Electric	Electric	Electric
Lighting						
Lighting	0% Fluorescent Hardwired	0% Fluorescent Hardwired	100% Fluorescent Hardwired	100% Fluorescent Hardwired	100% Fluorescent Hardwired	100% Fluorescent Hardwired
Space Conditioning						
Air Conditioner	None	SEER 13	SEER 13	SEER 13	None	None
Furnace	Electric	Electric	Electric	Electric	None	None
Heat Pump	None	None	None	None	SEER 13. HSPF 8.1	SEER 13. HSPF 8.1
Ducts	Leaky Uninsulated (Attic)	Typical R6 Insulation (Attic)	Typical R6 Insulation (Attic)	Typical R6 Insulation (Attic)	Typical R6 Insulation (Attic)	Typical R6 Insulation (Attic)
Water Heating						
Water Heater	Electric Standard, 92% EF	Electric Standard, 92% EF	Electric Standard, 92% EF	Electric Standard, 92% EF	Electric Standard, 92% EF	Electric Premium, 95% EF
Percent Improvement on St. Bernard Standard		0.0%	3.9%	9.9%	19.5%	29.8%
Percent Improvement on Pre-Katrina House		12.5%	15.9%	21.2%	29.6%	38.6%

Highlighted options are upgrades to observed St. Bernard Project specifications

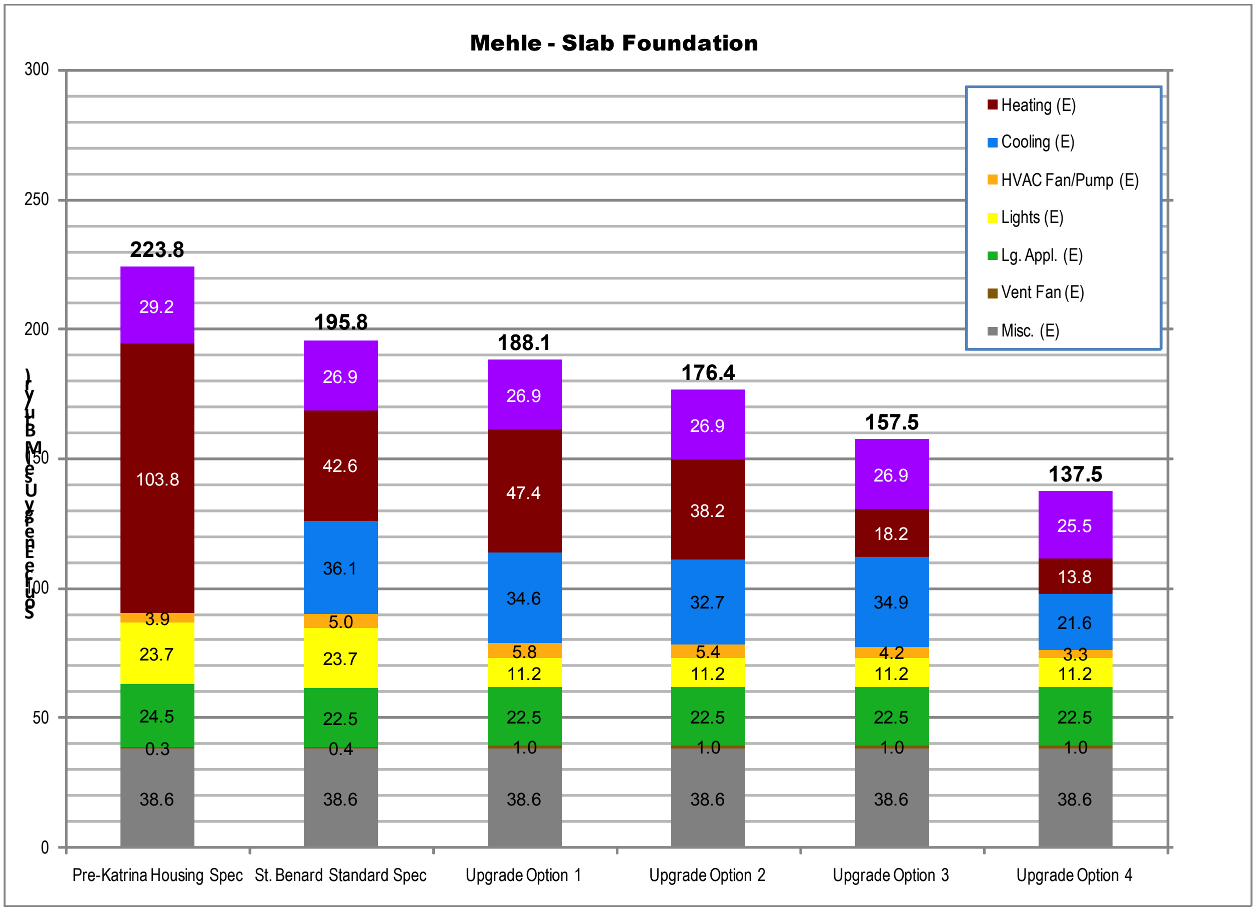


Figure 8. Mehle – Slab Foundation Energy Modeling Results

Table 4. Mehle - Open Pier Foundation Base Specifications and Option Upgrade Packages

Vented Crawl or Open Pier Foundation						
1894 sqft conditioned floor area, 189 sqft window area						
Category Name	Pre-Katrina Housing Spec.	St. Bernard Standard Spec.	Upgrade Option 1	Upgrade Option 2	Upgrade Option 3	Upgrade Option 4
Walls						
Wood Stud	R11 batts 2x4 16"o.c.	R13 batts 2x4 16"o.c.	R13 batts 2x4 16"o.c.	R13 batts 2x4 16"o.c.	R13 batts 2x4 16"o.c. + 1" foam	R13 batts 2x4 16"o.c. + 1" foam
Exterior Finish	Gray Vinyl Siding	Gray Vinyl Siding	Gray Vinyl Siding	Gray Vinyl Siding	Gray Vinyl Siding	Gray Vinyl Siding
Ceilings/Roofs						
Unfinished Attic	Ceiling R19 Fiberglass Batts Vented	Ceiling R19 Fiberglass Batts Vented	Ceiling R19 Fiberglass Batts Vented	Roof R19 Fiberglass Batts Unvented	Roof R30 Fiberglass Batts Unvented	Roof R38 Fiberglass Batts Unvented
Radiant Barrier	None	None	None	None	None	Yes
Foundation/Floors						
Crawlspace 4'	Uninsulated Vented	Uninsulated Vented	Uninsulated Vented	Uninsulated Vented	Uninsulated Vented	Ceiling R13 Vented
Windows						
Window Type	Single Pane, U-0.869 SHGC-0.619	Double Clear, U-0.49 SHGC-0.65	Double Clear, U-0.49 SHGC-0.65	Double Clear, U-0.32 SHGC-0.3	Double Clear, U-0.32 SHGC-0.3	Double Clear, U-0.32 SHGC-0.3
Airflow						
Infiltration	18.6 ACH 50	14.5 ACH 50	10.3 ACH 50	10.3 ACH 50	10.3 ACH 50	3.7 ACH 50
Mechanical Ventilation	None	Exhaust 50% of A-62.2	Exhaust 50% of A-62.2	Exhaust 50% of A-62.2	Exhaust 50% of A-62.2	Exhaust 50% of A-62.2
Major Appliances						
Refrigerator	Standard Top Mount Freezer	ENERGYSTAR Side-by-Side Freezer	ENERGYSTAR Side-by-Side Freezer	ENERGYSTAR Side-by-Side Freezer	ENERGYSTAR Side-by-Side Freezer	ENERGYSTAR Side-by-Side Freezer
Cooking Range	Electric Conventional	Electric Conventional	Electric Conventional	Electric Conventional	Electric Conventional	Electric Conventional
Dishwasher	Standard	ENERGYSTAR	ENERGYSTAR	ENERGYSTAR	ENERGYSTAR	ENERGYSTAR
Clothes Washer	Standard	ENERGYSTAR	ENERGYSTAR	ENERGYSTAR	ENERGYSTAR	ENERGYSTAR
Clothes Dryer	Electric	Electric	Electric	Electric	Electric	Electric
Lighting						
Lighting	0% Fluorescent Hardwired	0% Fluorescent Hardwired	80% Fluorescent Hardwired	100% Fluorescent Hardwired	100% Fluorescent Hardwired	100% Fluorescent Hardwired
Space Conditioning						
Air Conditioner	None	SEER 13	SEER 13	None	None	None
Furnace	Electric	Electric	Electric	None	None	None
Heat Pump	None	None	None	SEER 13. HSPF 8.1	SEER 13. HSPF 8.1	SEER 13. HSPF 8.1
Ducts	Leaky Uninsulated (Attic)	Typical R6 Insulation (Attic)	Typical R6 Insulation (Attic)	Typical R6 Insulation (Attic)	Typical R6 Insulation (Attic)	Typical R6 Insulation (Attic)
Water Heating						
Water Heater	Electric Standard, 92% EF	Electric Standard, 92% EF	Electric Standard, 92% EF	Electric Standard, 92% EF	Electric Premium, 95% EF	Electric Premium, 95% EF
Percent Improvement on St. Bernard Standard		0.0%	6.1%	24.9%	32.0%	34.7%
Percent Improvement on Pre-Katrina House		10.5%	15.9%	32.8%	39.0%	41.6%

Highlighted options are upgrades to observed St. Bernard Project specifications

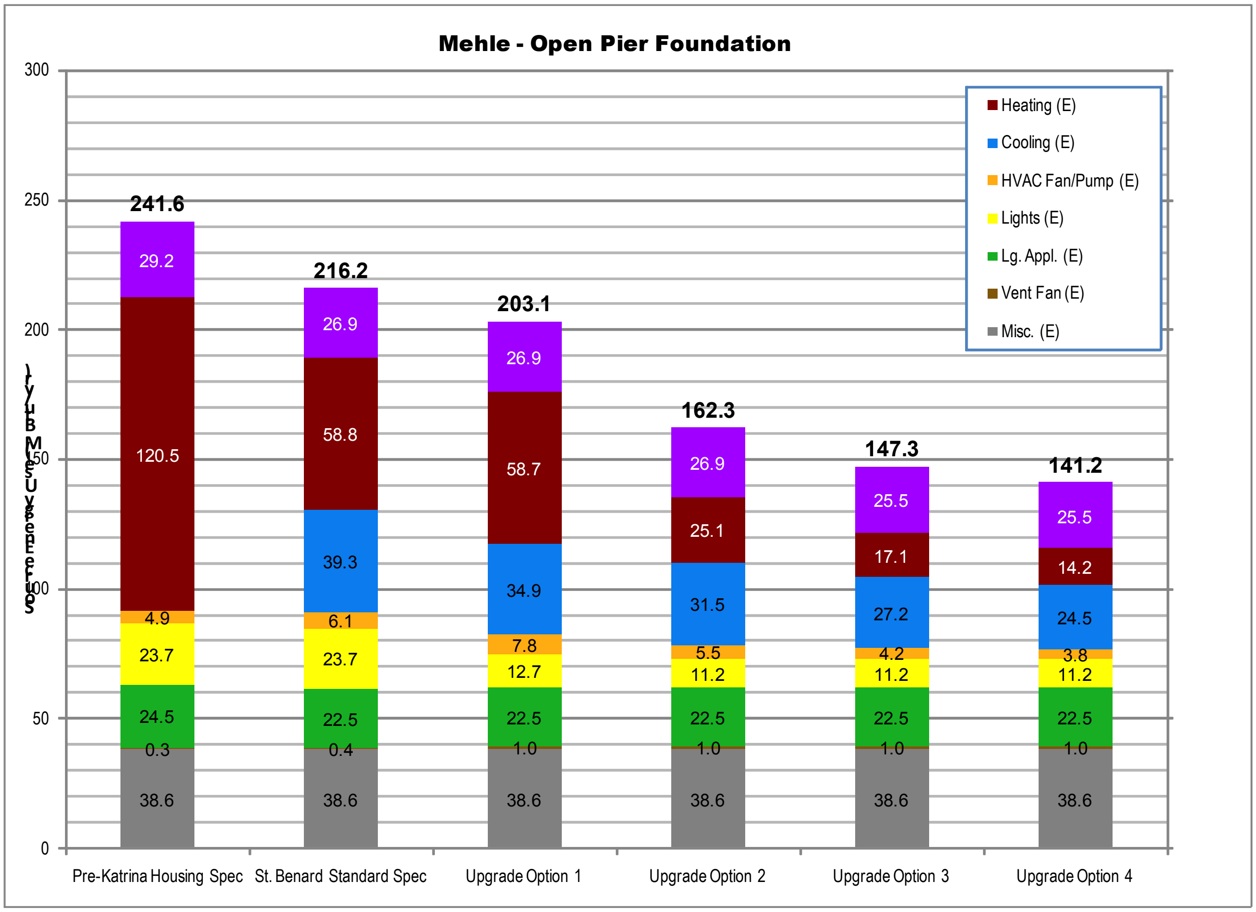


Figure 9. Mehle – Open Pier Foundation Energy Modeling Results

Modeling Conclusions

IBACOS considered option upgrades to feed into the modeling program including the use of increased air tightness of the envelope, higher R-values for attic and wall insulation, better windows, higher efficiency of mechanical equipment and appliances, and lighting packages.

For the St. Bernard Project slab-on-grade houses, the modeling results show significant energy saving can be achieved by improving the R-values of the insulation, standardizing a low U value and shading coefficient for all windows, installing fluorescent light fixtures, utilizing Energy Star appliances, using a heat pump for space conditioning and tightening up the envelope from air infiltration.

Additionally, the open pier versions saw similar savings with the same specification changes and the addition of insulation into the wood floor framing.

Construction Assessment

While on site, IBACOS observed 13 houses that were in various stages of retrofit construction. A wide range of construction practices were observed. The following pages highlight current construction practices that IBACOS deems to be potential “Quality Issues” as these practices may compromise building durability, energy efficiency, or occupant comfort.

Following each Quality Issue, IBACOS highlights an example of a construction “Best Practice” which, when applied to St. Bernard Project retrofit activities would result in overall better living environments for the occupants.

Quality Issue – Air Barrier Details

Mechanical Chase Lids

Homes with air handlers located in closets within the living space did not have any type of sealed lid where the ductwork was routed in to the attic through the ceiling plane.

Not sealing the lid at the top of duct or other mechanical chases may lead to 1) increased utility bills for the homeowners due to decreased thermal performance, 2) comfort issues due to the unwanted exchange of air from un-conditioned to conditioned spaces.

Figure 10. Photo of Open Mechanical Chase Lid

Best Practice – Air Barrier Details

Mechanical Chase Lids

The best method to seal duct chase lids is to install a panel product over the top of the chase and then cut the duct penetration through. This enables the installer to create a better fit through the lid and makes it much easier to seal. Fiberglass chinking is minimally effective in preventing the passage of air and so should not be used for air sealing. Expanding foam is the most effective sealant to use at this location.

Figure 11. Photo of Sealed Mechanical Chase Lid

Quality Issue – Air Barrier Details

Tub and Shower Draftstopping

Exterior walls behind tub and shower units are insulated but did not have any type of sheathing installed over the insulation to prevent drafts and convective air currents.

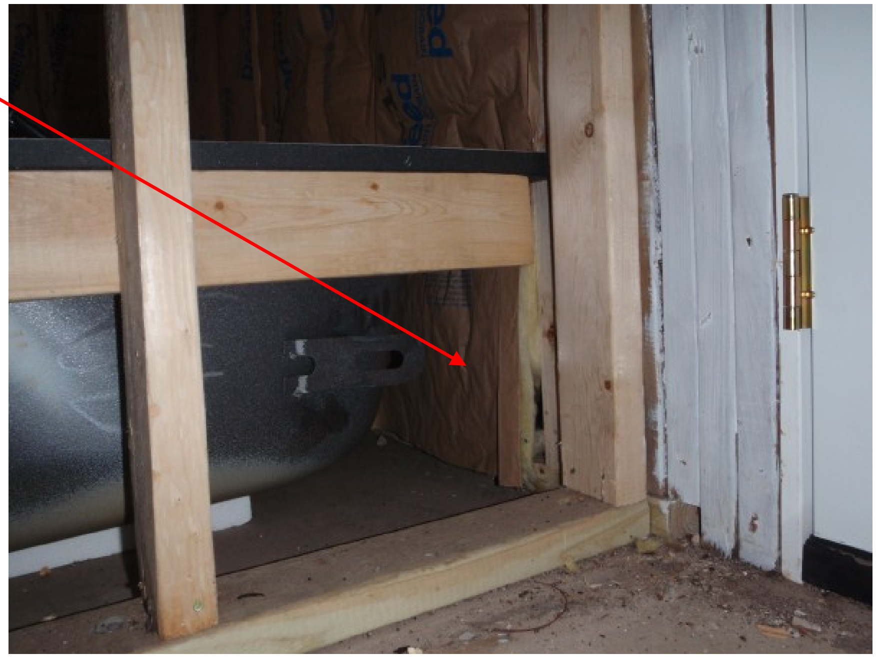


Figure 12. Photo of Missing Draftstopping

Best Practice – Air Barrier Details

Tub and Shower Draftstopping

This photo shows a cavity sheathed both to encapsulate the insulation so that the proper R-value is achieved and to avoid a convective loop.
A convective loop occurs when air rises along a warm surface and falls along a cold surface creating a circular movement of air. Such a loop transfers heat through the building assembly, requiring more energy to replace the lost heat in heating seasons and the lost cool air in cooling seasons.

Figure 13. Photo of Proper Draftstopping

Quality Issue – Air Barrier Details

Continuous Drywall

In homes with ceilings that are taller than the standard 8 feet a large gap was left open at the base of walls. While baseboard will cover this area it will still permit air infiltration or exfiltration if left unsealed.

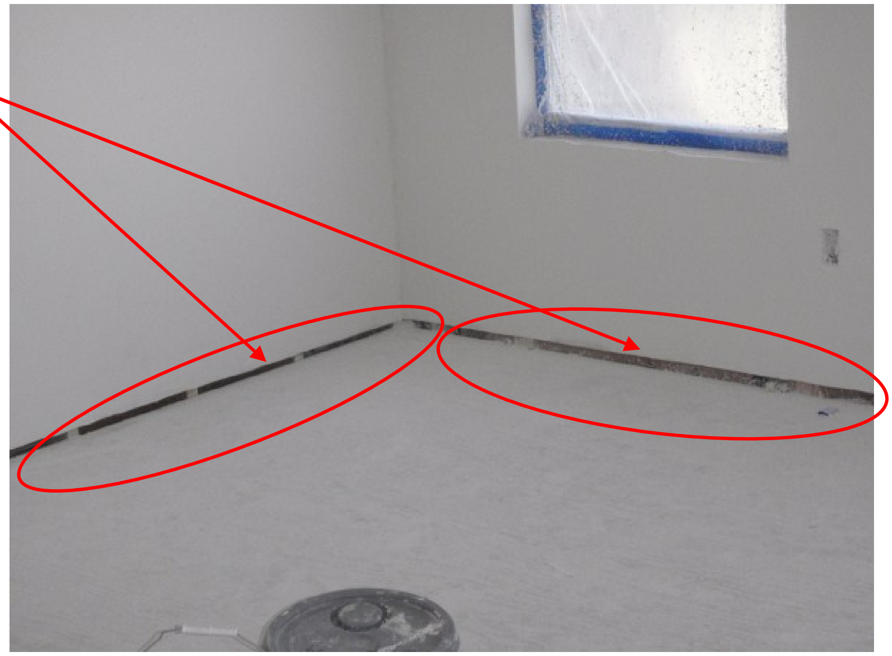


Figure 14. Photo of Drywall Gaps

Best Practice – Air Barrier Details

Continuous Drywall

Gluing the drywall to the perimeter framing will greatly increase the overall effectiveness of the insulation and air barrier.

Figure 15. Illustration of Continuous Drywall Application

Quality Issue – Air Barrier Details

Recessed Light Fixtures

Many homes are equipped with recessed light fixtures. All of the units are air tight and insulation contact rated. Installing these fixtures with the gasketed or caulked in trim ring is critical in achieving the air tightness of the fixture.

* The finished detail was not observed during this inspection but is included in this review for proper air sealing validation purposes.

Figure 16. Photo of Recessed Light Fixtures

Best Practice – Air Barrier Details

Recessed Light Fixtures

Drawing showing the location of sealant between the trim ring and finished ceiling.

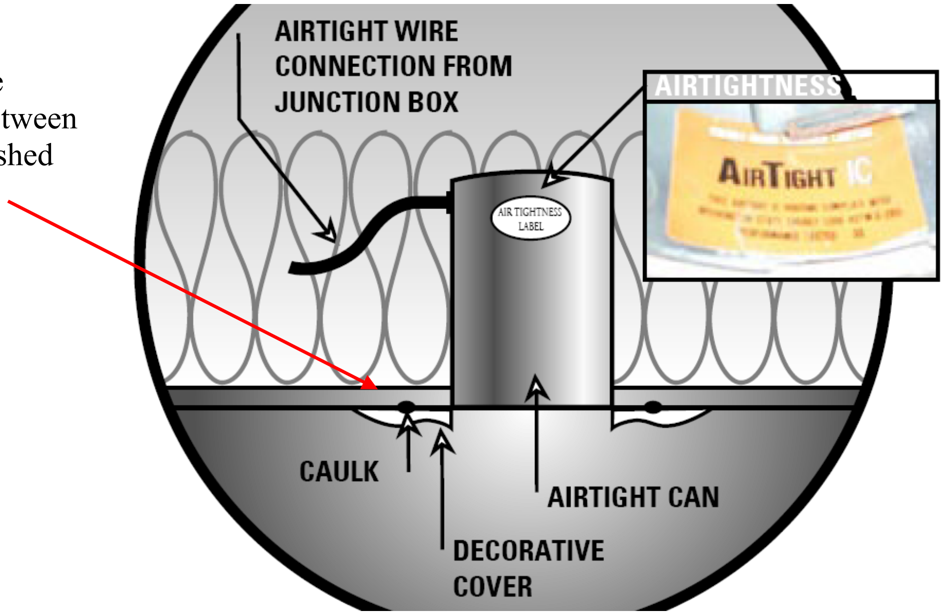


Figure 17. Illustration of Proper Air Sealing at Recessed Fixtures

Source: Building America Best Practices Series

Quality Issue – Air Barrier Details

Wood Frame Floor Air Sealing

Establishing a continuous and thorough air barrier between the thermal shell and outdoors is critical to the overall efficiency and comfort of the indoor environment. This open plank floor should be addressed and sealed with a panel product on the top surface or a continuous spray foam seal from beneath prior to installing the finished flooring.

Figure 18. Photo of Open Plan Flooring

Best Practice – Air Barrier Details

Wood Frame Floor Air Sealing

The most effective insulation and air sealing solution at framed floors on open pier foundations is to use a wash of closed cell foam over the entire underside of the floor system.

As an alternative, sealing the joints in the floor boards with canned spray foam and scraping the excess off once cured is an acceptable approach that requires additional labor and time.

Figure 19. Photo of Closed Cell Foam Under Floor Decking

Quality Issue – Insulation

Attic Kneewalls

At locations where insulated walls are adjacent to unconditioned attic space, the attic side of the wall should be sheathed, both to improve the airtightness of the wall assembly and to fully encapsulate the insulation so that the proper R-value is achieved.

Figure 20. Photo of Unsheathed Attic Knee Walls

Best Practice – Insulation

Attic Kneewalls

Sheathing the attic side of all kneewalls will ensure the batt insulation within the walls is encapsulated on all six sides. This will also ensure the effectiveness of the thermal envelope by preventing convection loops in the insulation.

Figure 21. Photo of Properly Sheathed Attic Kneewalls

Quality Issue – Insulation

Raised Floors

A consistent strategy to maintain the thermal boundary at raised floors on open pier foundations needs to be established.

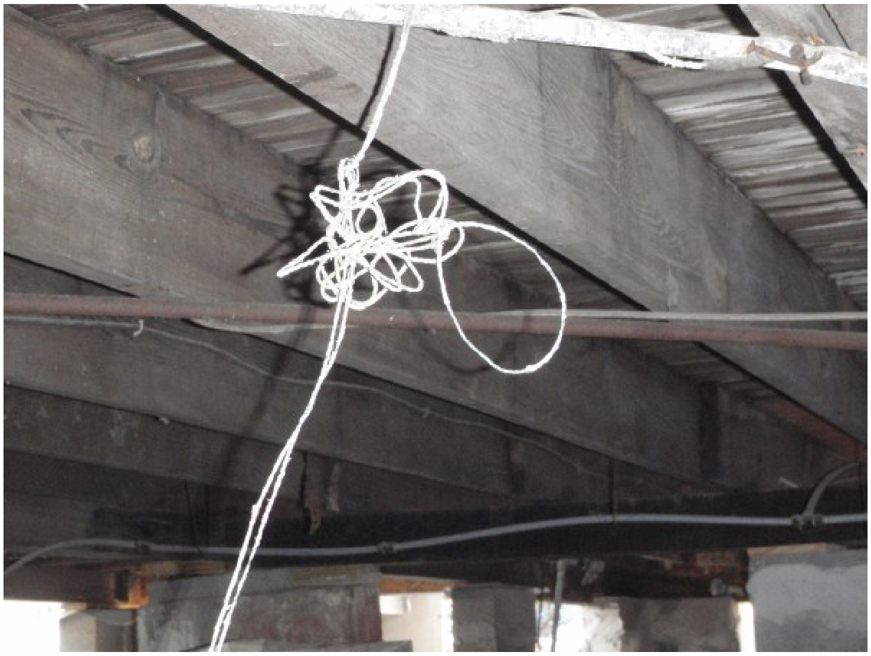


Figure 22. Photo of Uninsulated Raised Floors

Best Practice – Insulation

Raised Floors

The most effective insulation and air sealing solution at framed floors on open pier foundations is to use a wash of closed cell foam over the entire underside of the floor system. Thickness of closed cell foam will be dependent on desired R-value of the floor system.

Figure 23. Photo of Closed Cell Foam Under Floor Decking

Quality Issue – Insulation

Attics

Instances of missing insulation and air sealing at penetrations were observed in most attics.

Figure 24. Photo of Missing Attic Insulation at Ceiling

Best Practice – Insulation

Attics

The best practice at attics is to inspect the attic before insulation to ensure that all penetrations are sealed and then use a loose fill fiberglass blown in insulation (R-30) over the entire attic floor.

Due to the moisture retention capabilities of cellulose insulation, fiberglass fill is recommended for the hot humid New Orleans region.

Figure 25. Photo of Well Insulated Attic at Ceiling

Quality Issue – Insulation

Attics
Another instance of missing insulation in the attic.

Figure 26. Photo of Missing Attic Insulation

Best Practice – Insulation

Attics
An alternate method of insulating the attic would be to insulate against the roof deck with closed cell foam. This practice provides a total air seal and thermal boundary that minimizes the extreme temperature effects on the air handling equipment and ductwork.

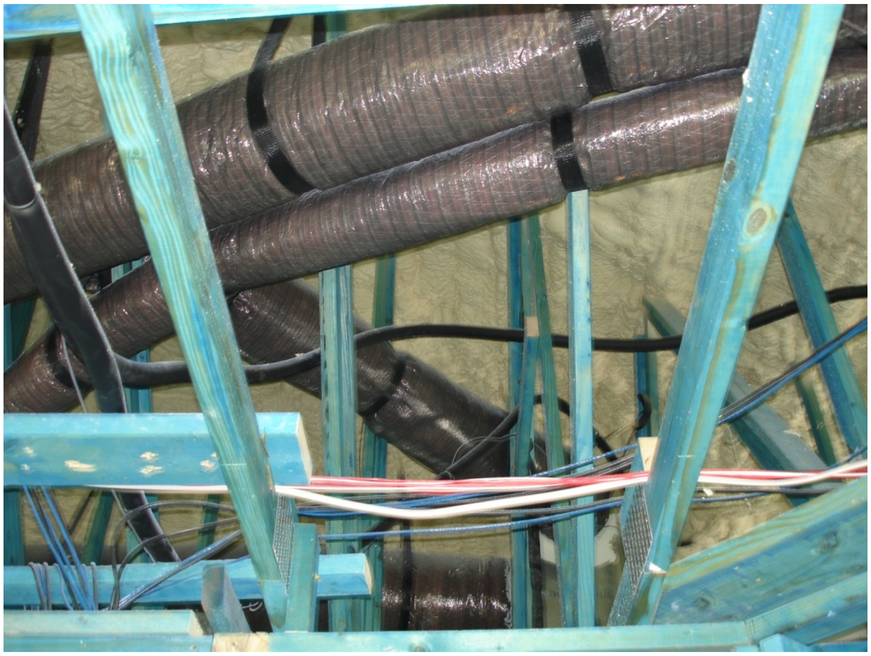


Figure 27. Photo of Attic Insulation Under Roof Deck

Quality Issue – Insulation

Walls

In some instances, the fiberglass batts did not completely fill the stud bays. Often there was a gap at the top plate which will reduce the effectiveness of the insulation.

The use of Kraft-faced batts is not recommended for hot and humid climate regions. The use of unfaced batts is the better approach that will provide more drying capability to the wall assembly.

Figure 28. Photo of Short Kraft Faced Fiberglass Batts

Best Practice – Insulation

Walls

Use of fiberglass insulation without any vapor barrier allows the wall assembly to breathe and dry to the inside. Additionally, it is far easier to do a thorough installation with unfaced batts.

Figure 29. Photo of Proper Installation of Unfaced Batts

Quality Issue – Mechanical Systems

Return Air Strategy
Panned, or using framing cavities for duct return systems are inherently difficult to seal and tend to draw air from building cavities instead of living spaces which may lead to comfort and efficiency issues.

Figure 30. Photo of Panned Return

Best Practice – Mechanical Systems

Return Air Strategy
Building a sealed return plenum box beneath the air handler is the best way to maximize the return air capability of the unit and ensure that the air is coming from the living space instead of framing cavities or the attic.

Figure 31. Photo of Sealed Return

Quality Issue – Mechanical Systems

Duct Sizing

Many of the duct systems that were observed did not seem to have any definitive sizing strategy. Duct systems that use similar size branch ducts may not deliver the necessary air amounts to certain rooms. This practice may result in comfort and efficiency issues that a homeowner will compensate for by adjusting the thermostat.

Figure 32. Photo of Identically Sized Ducts

Best Practice – Mechanical Systems

Duct Sizing

Requiring the mechanical contractor to follow and submit the ACCA Manual D "Residential Duct Systems" procedure will help to ensure that required air flows to specific areas of the house are met. Manual D is a nationally-recognized standard for designing residential HVAC duct systems.

For additional information: www.acca.org/industry/system-design/process

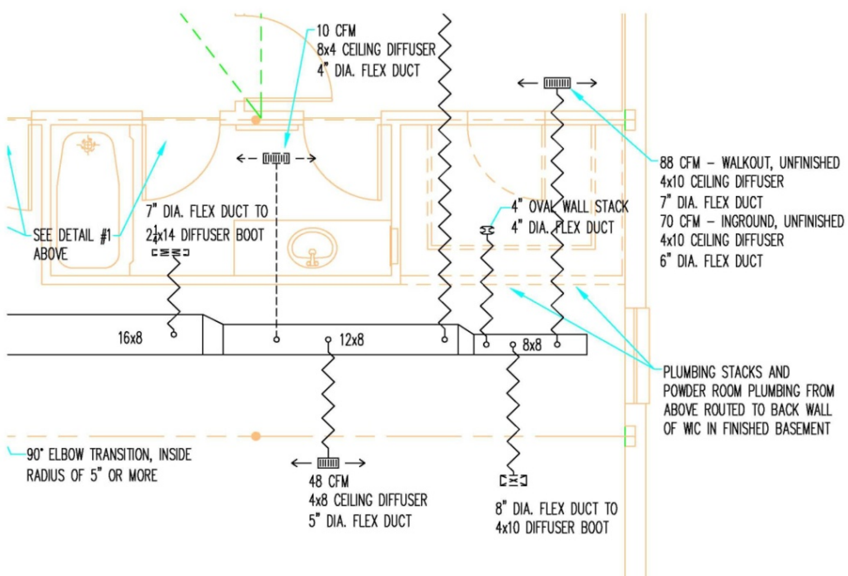


Figure 33. Diagram of Properly Sized Duct Systems

Quality Issue – Mechanical Systems

AHU Sizing

ACCA Manual J load calculations were not available during site visit.

Sizing of air handlers and cooling system should be verified to Manual J loads on each dwelling. This will maximize efficiency and allow better humidity control and comfort within the living spaces.

Figure 34. Photo of Oversized HVAC Equipment

Best Practice – Mechanical Systems

AHU Sizing

Utilizing protocols outlined in the ACCA Manual J “Residential Load Calculation” design guidelines will ensure the properly sized equipment will match the parameters of the home and result in optimum operation and long term performance.

For additional information: www.acca.org/industry/system-design/process

Figure 35. Photo of Properly Sized HVAC Equipment

Quality Issue – Mechanical Systems

Attic Exhaust Fans

Concerns regarding attic exhaust fans exist due to the lack of a comprehensive and thorough air sealing between the attic and living space. Without a tight air barrier, the attic fan can pull conditioned air from the living space and induce air intrusion from outdoors.

Figure 36. Photo of Attic Exhaust Fan

Best Practice – Mechanical Systems

Attic Exhaust Fans

Installing the appropriate soffit and either ridge or off ridge venting to remove excess heat from the attic is a better practice than the electric exhaust fan due to the impact on the living space that the fan can induce.

Figure 37. Photo Attic Ridge Venting

Quality Issue – Drainage Plane Detailing

Door Flashing

No comprehensive flashing strategy was observed at exterior entry doors. Standardizing a complete strategy that includes a pre-formed sill pan beneath the threshold and integrating the sill pan with self-stick flashing at the jambs and head will insure a weather tight assembly.

Figure 38. Photo of Missing Door Flashing

Best Practice – Drainage Plane Detailing

Door Flashing

Example of a pre-formed sill pan beneath an entry door with the front lip extending out and over the drainage plane.

Figure 39. Photo of Proper Door Sill Flashing Installation

Quality Issue – Drainage Plane Detailing

Door Flashing

No comprehensive flashing strategy was observed at entry doors.

Figure 40. Photo of Missing Door Flashing

Best Practice – Drainage Plane Detailing

Door Flashing

Standardizing a flashing strategy for new door installations that includes a sill pan beneath the threshold and properly applied self-stick flashing and drip edge over the head will minimize any potential for water intrusion at doorways.

Figure 41. Photo of Proper Door Flashing Installation

Quality Issue – Drainage Plane Detailing

Drip Caps at Door Heads

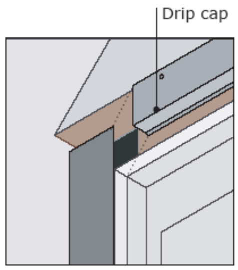
No "z" flashing or drip edges were installed on the brick mould over the heads of doors.

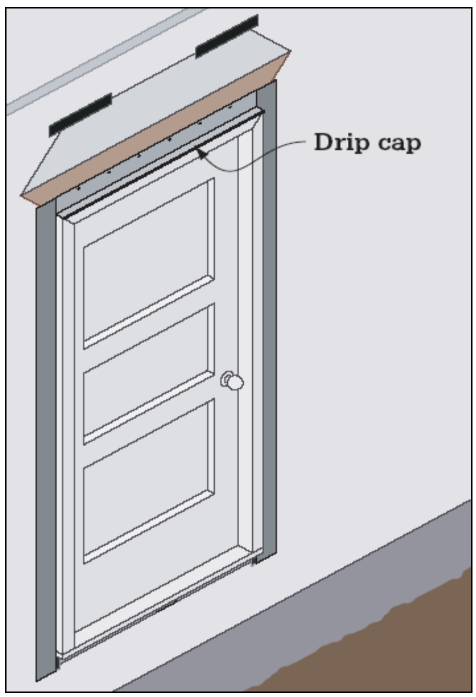
Figure 42. Photo of Missing Drip Cap at Door Head

Best Practice – Drainage Plane Detailing

Drip Caps at Door Heads

Drip edges over doors ensure bulk water will drain down and away from the head of doorways minimizing the potential for water intrusion.





Figures 43 and 44. Illustrations of Proper Drip Cap Installation

Quality Issue – Drainage Plane Detailing

Window Flashing
Self-stick window flashing was observed on exposed windows. Often the flashing pieces were mis-lapped with one another and did not maintain the shingling effect.

Figure 45. Photo of Mis-lapped Window Flashing

Best Practice – Drainage Plane Detailing

Window Flashing
Flashing should start at the sill with the side jamb pieces layering over the sill and the head over the jambs. Cutting 2 angle cuts in the house wrap at each corner of the head and creating a flap that can be folded over the flashing and taped is the best strategy at maintaining the shingling effect when flashing windows.

Figure 46. Photo of Proper Window Flashing Installation

Quality Issue – Drainage Plane Detailing

Vinyl Trim Blocks
Wire penetrations and decorative trim boxes are common leak points if not detailed correctly.

Figure 47. Photo of Unsealed Wall Penetration

Best Practice – Drainage Plane Detailing

Vinyl Trim Blocks
Utilizing self-stick flashing in the proper shingling sequence will minimize any potential for water intrusion at these locations.

Figure 48. Photo of Properly Sealed Wall Penetration

Quality Issue – Roofing

Drip Edge Application
Inconsistent practices were observed at drip edge applications at roof edges. The drip edge should be installed directly against the roof deck at the eave followed by the underlayment paper followed by the drip edges on the rakes. This layering sequence maintains the shingling effect to the gutters.

Figure 49. Photo of Improperly Installed Drip Edge

Best Practice - Roofing

Drip Edge Application
In this instance, the drip edge was installed correctly with the drip edge installed first at the eave and the underlayment over the edge followed by drip edge at the rakes.

Figure 50. Photo of Properly Installed Drip Edge

Quality Issue – Roofing

Roof Boots

Proper roof boot coverage is necessary to promote good drainage. In this instance, there is not adequate shingle coverage at the edges.

Figure 51. Photo of Improper Roof Boot Installation

Best Practice - Roofing

Roof Boots

Example of a proper installation. The lower part of the flange overlaps the lower shingles and the side and upper shingles overlap the flange.

Figure 52. Photo of Proper Roof Boot Installation

Quality Issue – Roofing

Underlayment at Roof Edges

When roofing practices were observed, the roofing paper underlayment did not completely cover the roof rake edges.

Figure 53. Photo of Insufficient Underlayment at Roof Edge

Best Practice - Roofing

Underlayment at Roof Edges

Running each course of building paper all the way to the rake edges is the best practice.

Figure 54. Photo of Proper Underlayment Installation at Roof Edge

Quality Issue – Exterior Bulk Water Management

Roof Drainage

Rain water and ground water must be properly managed at the foundation and site in order to enhance the long-term durability of a home. If the ground around the house and the foundation system are saturated, then the possibility for water to penetrate the foundation or for moisture to wick through the foundation by capillary action is greatly increased.

In many instances, gutter downspouts deposit bulk water from the roof next to foundations.

Figure 55. Photo of Downspout Discharge Against Foundation

Best Practice – Exterior Bulk Water Management

Roof Drainage

The best way to eliminate any potential moisture issues at the foundation is to direct water from downspouts to a yard bubbler or sump pit in the yard.

If that is not feasible, at a minimum, taking the time to properly position splashblocks at downspouts so as to direct bulk water away is recommended.

Figure 56. Photo of Effective Roof Drainage Discharge

Quality Issue – Exterior Bulk Water Management

Grade To Siding Reveals

In some instances there was insufficient grade separation between wall cladding and the landscaping/grade.

Figure 57. Photo of Insufficient Grade Separation

Best Practice - Exterior Bulk Water Management

Grade To Siding Reveals

Ideally, there is a minimum of 6 to 8 inches between the ground surface and the starting course for siding. This separation eliminates any potential for moisture wicking into the cladding or framing material. The gap also hinders insect activity into the framing.

Figure 58. Photo of Adequate Grade Separation

Quality Issue – Tub and Shower Detailing

Tub Surround Details

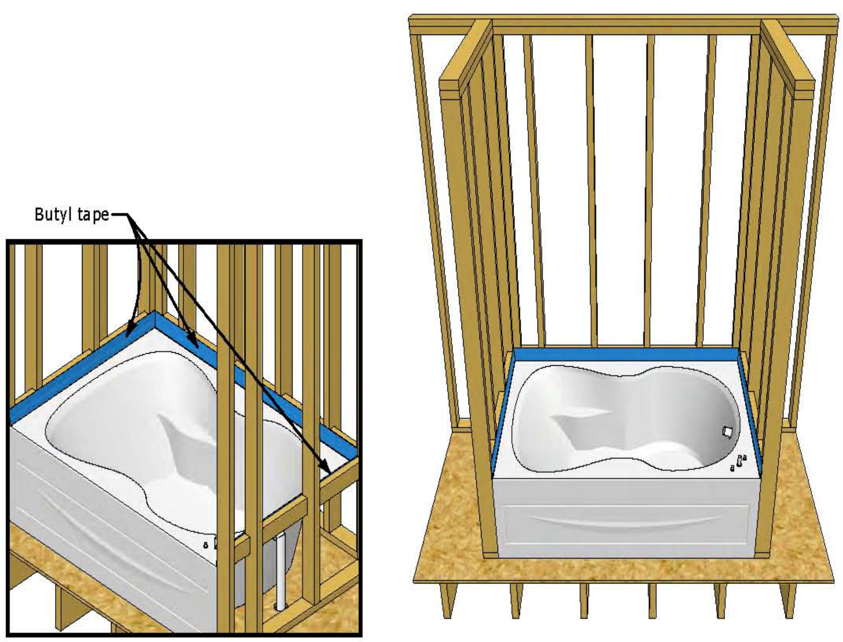
No comprehensive flashing strategy was observed at the nailing fin of tub and shower units. In most cases the wall board was installed directly upon the unit. This detail will eventually deteriorate due to the wicking ability of the gypsum based backer board.

Figure 59. Photo of Insufficient Flashing Surrounding Tub

Best Practice - Tub and Shower Detailing

Tub Surround Details

Install 4” butyl flashing over the nailing fin of the tub unit and stick to the installed blocking. Installing a 4” butyl tape over the tub/shower nailing fin to the surrounding framing can prevent water from getting into the wall cavity.



Figures 60 and 61. Illustrations of Proper Tub Surround Flashing

Quality Issue – Tub and Shower Detailing

Tub Surround Details

Another instance where the backer board was installed tightly to the tub.

Figure 62. Photo of Improper Backer Board Installation

Best Practice - Tub and Shower Detailing

Tub Surround Details

In this instance the backer board was held up and installed on the top edge of the fin. This practice is acceptable as long as the previously described flashing detail is carried out.

Figure 63. Photo of Proper Back Board Installation

Summary

The staff at St. Bernard Project are bringing tremendous assistance and value to many people in the New Orleans area that have been affected by the damaging effects of hurricane Katrina. The information provided in this report is intended to help St. Bernard Project in terms of improving the energy efficiency and long-term durability of the buildings that are being reconstructed. Although many of the best practice methods described will require product or process changes, some of the recommendations will only require additional training and supervision of the volunteer labor.

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