NAHB RESEARCH CENTER
INDUSTRY PARTNERSHIP
FOR HIGH PERFORMING HOMES

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30% Energy Efficiency Solution Package Presentation

Prepared For:
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30% Energy Solution Package Presentation

Mixed-Humid Climate Zone 4

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October 2011

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BAP 30% Energy Solution
New Construction Test House

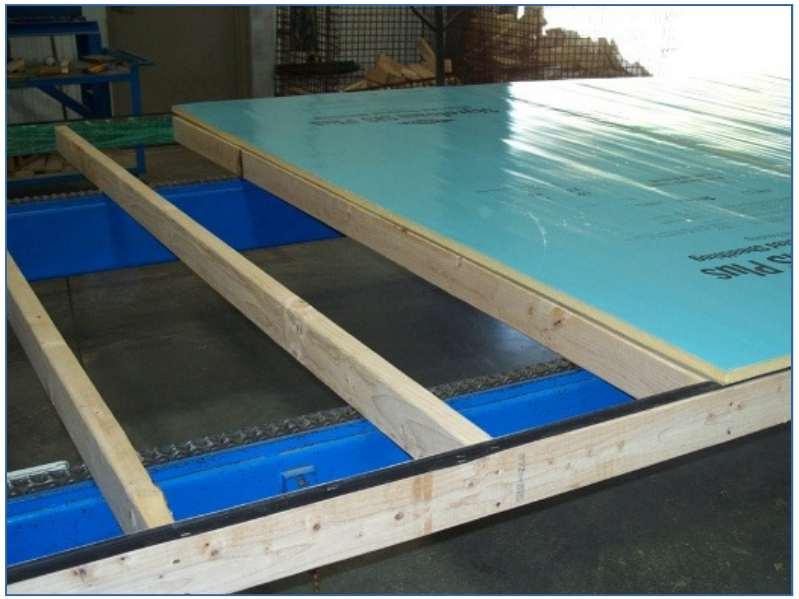
- Single-story slab-on-grade single family design
- Mixed-Humid CZ 4
- Production builder
- Same model with same floor plan and orientation two lots away

Cost Effective Energy Solutions

Design Considerations	Solution
Improved Air Sealing	Detailed air sealing improvement measures balanced with cost and consistency of installation
Increased Insulation	Optimized framing plus exterior structural insulation to increase thermal performance
Improved HVAC system efficiency, air delivery, & occupant comfort for single-story slab-on-grade designs	Redesigned HVAC system: Equipment located in conditioned space Return duct simplified & located in conditioned space Supply duct deeply buried, well sealed, trunk located within truss chase
Quality Assurance & Control	Choose construction details with consideration for builder & trade approaches Construction specifications, preparatory meetings, and site monitoring
Repeatable Design	Enhanced features to optimize performance and cost as well as ensure consistent installation

Thermal Envelope

Feature	Standard Practice	NCTH Enclosure Enhancements
Foundation	Slab on grade 2’ perimeter insulation, R-10	Standard plus: R-10 edge insulation
Walls	2x4 frame, 16” o.c. R-13 batt insulation, Class 1	Standard plus: Panelized walls 1” Structural Insulated Sheathing (SIS), R-6.5 Continuous drywall method 3-stud corners
Windows	U = 0.37	U = 0.34, SHGC = 0.26
Air Sealing	Wall bottom plates caulked Penetrations sealed Window rough openings foamed	Standard plus: SIS panels – Gasketed at top & bottom plates – Taped seams – Provides WRB & air barrier Foam over top plates from attic Foam over HVAC trunk & register boots Framed cavities & knee wall air barriers Garage-side drywall & electrical boxes
Roof/attic (vented)	Truss, top chord overhang R-38, loose fill fiberglass	Raised heel truss, cantilevered overhang R-49, loose fill fiberglass



Factory installed sheathing gaskets

Factory installed sheathing tape

Partition wall held 1” at exterior for continuous drywall method

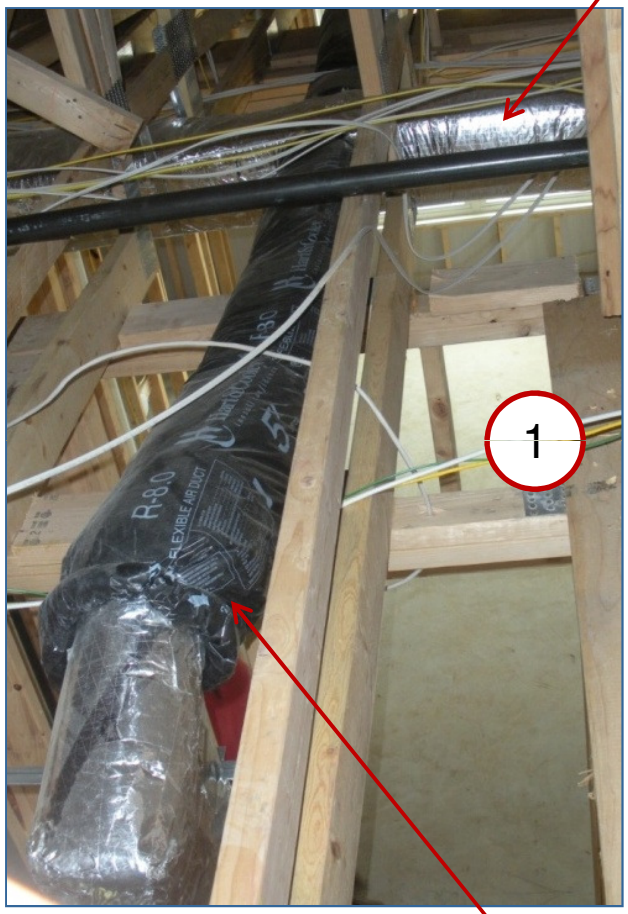
Top plates foamed from attic


Erosion Control
Measures in Place
• Do Not Drive Over
• Do Not Park On
• Do Not Damage
• Do Not Remove
Violations Will Result in
Back Charge to Your Company
05.12.2009

Systems

System	Standard Model	NCTH System Enhancements
Heating	92,000 Btuh gas furnace AFUE 92%, 1-stage, fixed speed Installed in attic	46,000 Btuh gas furnace AFUE 95%, 2-stage, ECM blower Located in conditioned space
Cooling	4-ton, SEER 13	2.5-ton, SEER 15
Supply duct	Attic	Simplified (28% less surface area) Installed within truss chase Deeply buried in attic Trunk & boots foamed
Return duct	Attic	Simplified (70% less surface area) Central return & bedroom transfer grilles Located in conditioned space
Filtration	Standard 1”	MERV 10 pleated media
Ventilation	Exhaust: bath exhaust fan and control	Supply: central fan integrated (ducted to return), damper control integrated with thermostat
Water heater	Power vent natural gas, EF 0.74, located near garage	Tankless direct vent, EF 0.98, centrally located to fixtures
Lighting	n/a	90% fluorescent
PV	None	4.9 kW

HVAC main supply trunk centrally located and installed at sheetrock level



HVAC supply branch installed between trusses

Foamed-over supply trunk & boots (ventilation air flexible duct above)

Deeply buried ducts

Simulated Energy Savings – BEopt v1.1

	Estimated Annual Source Energy (Mbtu/yr)			Estimated Annual Utility Bills ($/yr)		
End Use	BAB	NCTH	Savings	BAB	NCTH	Savings
Fixed Charges				192	192	0
Space Heating	121.3	74.2	39%	1,458	891	567
Space Cooling	7.5	3.7	50%	94	47	47
HVAC fan	5.7	3.4	40%	72	43	29
Hot Water	21.7	11.0	50%	261	132	130
Lighting	24.2	19.0	21%	306	240	65
Appliances & MELs	61.6	55.0	11%	776	694	83
OA Ventilation	3.2	1.9	40%	40	24	16
Total	245.2	168.2	31%	$3,200	$2,263	$937
Total (size adjusted)	243.3	168.2	31%			
Site Generation		(49.4)			($880)	
Net	243.3	118.8	51%	$3,200	$1,383	$1,817

Incremental Cost Analysis

Incremental Costs of Energy Efficiency Options ($)			
Group	**Category**	**Builder's Net Additional Cost** (labor & materials)	**Adjusted** (no framing credit)
Framing	1" SIS sheathing	1591	
	Panelized walls credit	(3320)	
	Truss (raised heel & HVAC chase, simplified without coffers, adjusted for site built coffers & air barriers)	0	
Roof/attic	R-49 insulation	525	
Air sealing	Spray foam top plates & duct	1300	
Windows	Improved efficiency rating	150	
	Jamb extensions	350	
HVAC	Entire System	238	
Plumbing	Tankless direct vent water heater	350	
Lighting	100% CFL	280	
Total	Additional cost of options	1464	4784
Net total	Adjusted for 10% builder margin	1627	5316
Net Monthly Cost	Mortgage net monthly cost	11	$35
	Utilities net monthly cost	(78)	(78)
	Net monthly cost	(67)	(43)

Performance Testing

- The Research Center tested and monitored both homes
- Same floor plan and orientation two lots apart
- Infiltration and Duct Leakage were significantly improved in the NCTH

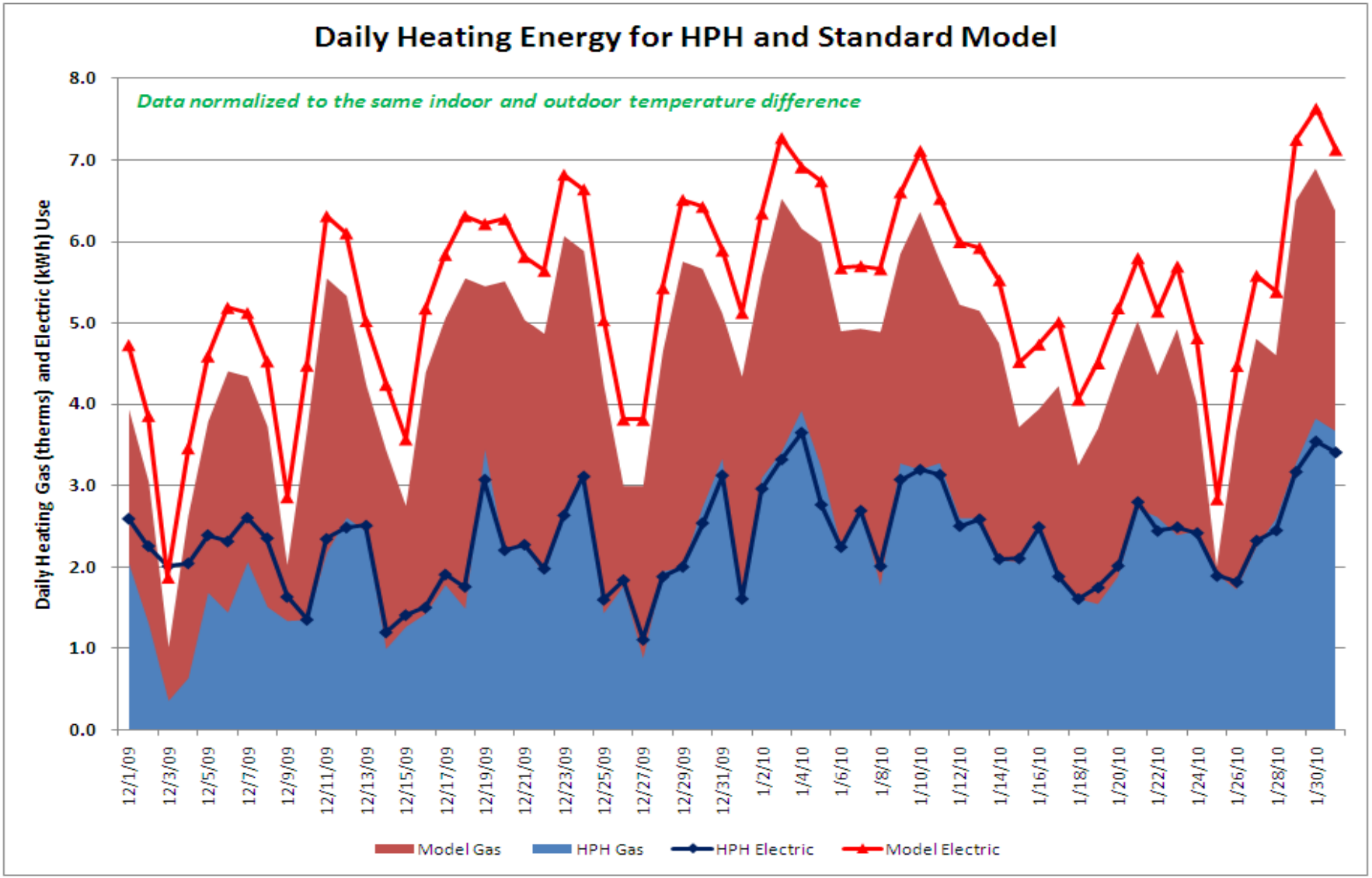
Performance Metric	Standard Model	NCTH	Change	Units
House Size	2,587	2,498	- 3%	sq.ft.
House Volume	23,542	22,732		cu.ft.
Infiltration	2,717	1,021	- 61%	CFM50
	6.9	2.7		ACH50
	0.37	0.15		ACHnat
Normalized Infiltration	1.05	0.41		CFM50/sq.ft.
Total Duct Leakage	165	85	- 48%	CFM25
Duct Leakage to Outside	74	0	- 100%	CFM25

Performance Monitoring

- Monitoring results for the NCTH heating energy aligned well with simulated energy savings
- Data was normalized to the same indoor and outdoor temperature difference
- Note: The standard model met ENERGY STAR certification criteria

Performance Metric Dec '09 – Jan '10	Standard Model	30% Test House	Change
Gas Heating Energy (therms)	286	137	- 52%
Furnace Electricity (kWh)	335	145	- 57%

Performance Monitoring



Summary

- ✓ 30%+ BAB Energy Savings
- ✓ HERS Index 60 (41 with PV)
- ✓ Repeatable & Cost Effective:
  - ✓ Thermal Enclosure
  - ✓ Air sealing
  - ✓ HVAC design
  - ✓Hot Water
  - ✓Lighting

- ✓ Builder has implemented many of the NCTH enhancements as standard practice in a subsequent development

Appendix 1: Builder Promotion

Builder promotion and education of the High Performance NCTH

Appendix 2: Air Barriers

Sealed air barrier adjacent to garage knee wall

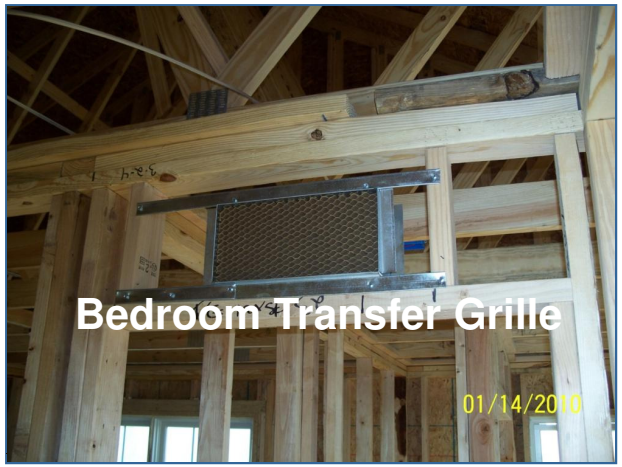
Sealed air barriers at fireplace framed cavity and coffered ceiling beyond

Appendix 3: Top plates sealed from the attic with foam

Sealed top plates and air barrier

Sealed top plates of partition wall and exterior wall

Appendix 4: Additional Photos

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