ZERO ENERGY HOUSE

NEBRASKA

ZERO ENERGY HOUSE

SITE

SYSTEMS

MATERIALS

DESIGN

ZERO ENERGY HOUSE

SYSTEMS

PERFORMANCE

CONSTRUCTION

Zero-Net Energy Building Science Research

Nebraska Housing Case Study

Timothy L Hemsath

Introduction

What makes a new home sustainable? There is no simple answer and no silver bullet to reducing energy consumption, choosing the right building material or perfectly designed floor plan. Every case is different and every home-owner has their own perspective. To answer the question I was motivated to assemble this mini-portfolio of homes to begin identifying current best practices.

This booklet contains five newly constructed Nebraska homes. Each example identifies what high performance green building design elements, technologies and systems builders, architects and home-owners are using. The following five homes are not all Nebraska has to offer as examples, but are a sample in order to help the next generation of new homes seeking to be energy efficient and sustainably designed a place to begin.

The format of each case study house begins with a short summary and partners involved in the project. The following pages identify and describe each homes features with a number and image. Not all the numbers will appear on the background image as the identified elements are not visible. Each case study can be printed and used individually or in tandem with others.

This research was part of a larger collaboration at the University of Nebraska involving faculty from various campuses and departments. I would like recognize the faculty Yong Cho, Peter Hind, Jim Goedert, Andrew Jameton, Richard Lomneth and George Morcous.

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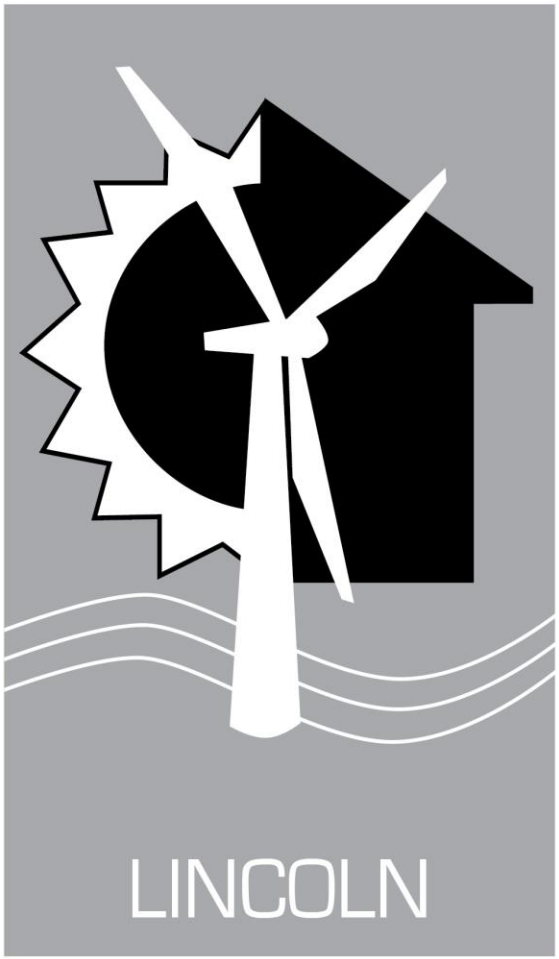
University of Nebraska Lincoln

ARCSPACE LINCOLN

Located in North Lincoln, NE the Archspace home was designed and built by students from the University of Nebraska - College of Architecture. The home was constructed for the first time home buyer program, Neighbor Works. The design of the home uses passive solar techniques, materials, and building methodology that are essential for sustainable design. The geothermal heating and cooling system in cooperation with other solar design decisions can provide natural ways of heating and cooling a home.

P A R T N E R S

- NeighborWorks® America
- University of Nebraska-Lincoln
- UNL Architecture Students
- Nebraska Department of Economic Development
- City of Lincoln Housing and Urban Development
- State Farm Insurance
- Woods Charitable Fund
- Straw Sticks and Bricks
- Tech Masters
- Stephens and Smith
- EMO Flooring
- Crawford Plumbing
- Pella Windows



⑤ Geothermal HVAC System

A Geothermal heating and/or cooling system uses the earth's ability to store heat in the ground and/or thermal water sources. Under the home are vertical geothermal wells which provide 1.5 tons of heating / cooling loads for the home.

⑥ Cork Flooring

Cork has natural properties that are anti-allergenic and resistant to insects. A naturally occurring waxy substance in cork called suberin, is naturally fire resistant and doesn't release any toxic off-gassing. These natural properties plus the coatings used to seal cork flooring make it healthy and safe.

⑦ LOW V.O.C. Paints

V.O.C.'s are volatile organic compounds, these are toxins in typical household paints. Also 150 of the toxins have been linked to cancer, the lower the V.O.C the better indoor air quality.

⑧ Wheatboard Cabinets & Recycled Counter tops

Wheatboard cabinets were used in the kitchen and bathrooms, which use by-products from the processing of natural Midwest grain, and have are uera-formaldehyde free finish. The counter tops for the cabinets are made from post consumer recycled paper, glass, and plastic. The surfaces are durable and easy to clean, and because of their non-porous surface are resistant to stains and bacteria. Recycled plastic used in the carpet removes the toxic chemicals needed to process traditional carpet, which reduces the amount of V.O.C's found in carpet.

⑨ Loft Space

This lofted space can be easily be converted to a bedroom which allows flexibility in the years to come.

NEBRASKA RESEARCH INITIATIVE FUNDING

Interdisciplinary Building Science Research Partners:

- University of Nebraska-Lincoln College of Architecture
- Department of Chemistry at the University of Nebraska-Omaha
- University of Nebraska-Lincoln College of Architectural Engineering and Construction
- University of Nebraska Medical Center College of Public Health

ARC SPACE

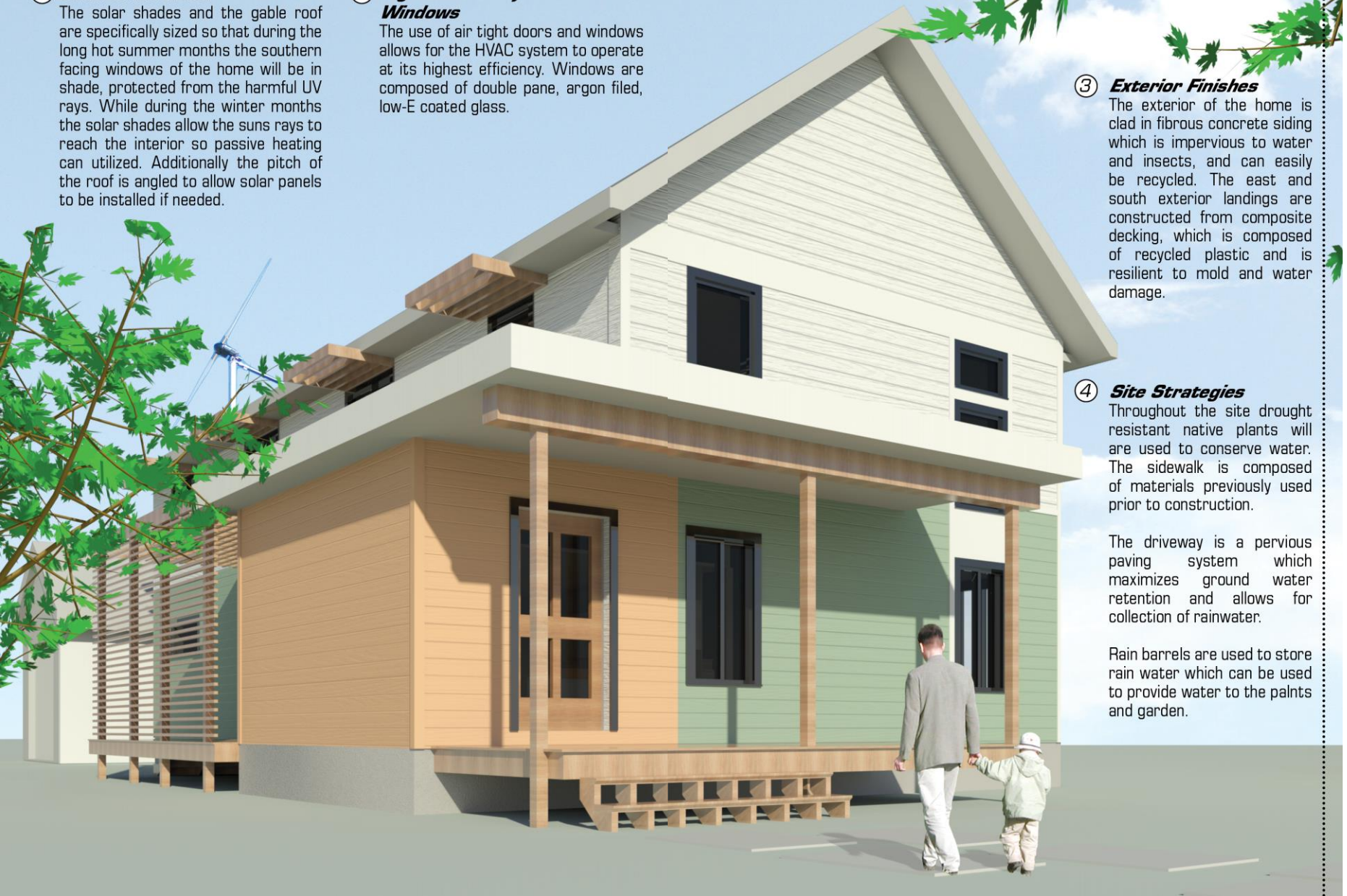
LINCOLN

1 Solar Orientation

The solar shades and the gable roof are specifically sized so that during the long hot summer months the southern facing windows of the home will be in shade, protected from the harmful UV rays. While during the winter months the solar shades allow the suns rays to reach the interior so passive heating can utilized. Additionally the pitch of the roof is angled to allow solar panels to be installed if needed.

2 High Efficiency Doors and Windows

The use of air tight doors and windows allows for the HVAC system to operate at its highest efficiency. Windows are composed of double pane, argon filed, low-E coated glass.



3 Exterior Finishes

The exterior of the home is clad in fibrous concrete siding which is impervious to water and insects, and can easily be recycled. The east and south exterior landings are constructed from composite decking, which is composed of recycled plastic and is resilient to mold and water damage.

4 Site Strategies

Throughout the site drought resistant native plants will are used to conserve water. The sidewalk is composed of materials previously used prior to construction.

The driveway is a pervious paving system which maximizes ground water retention and allows for collection of rainwater.

Rain barrels are used to store rain water which can be used to provide water to the palnts and garden.

University of Nebraska Lincoln

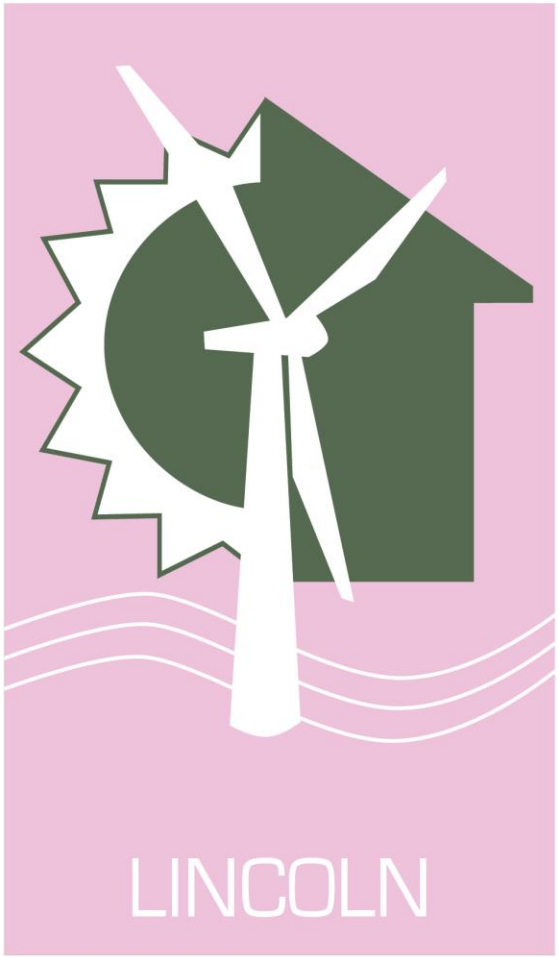
THE MADISON ..... LINCOLN

Located in SW Lincoln, the Madison was designed by Authenticity LLC, and constructed by Rezac Construction. The Madison home will produce its own electricity through a 9 Kw photovoltaic system. The Madison utilizes the temperature of the earth for heating and cooling through a geothermal system.

In addition to efficient heating and cooling a tight seal from the exterior is provided by air tight windows, doors, and a superior insulated building. Fresh air ventilation with energy recovery system is utilized to provide clean air into the home. Throughout the house extensive applications of recycled products have been used, in place of conventional materials.

P A R T N E R S

- Mike Rezac, Rezac Construction
- Michelle Penn, Authenticity, LLC
- LES (Lincoln Electric System)
- Nebraska Energy Office
- NPPD (Nebraska Public Power District)
- Carrier
- Ecostar
- General Electric
- Pavstone
- Andersen Windows
- Dryvit System Inc.



(10) *Site Strategies*

Conservation of water to the exterior by planning two different rain barrels into the gutter system. Native plantings and grass were used to reduce long term maintenance issues. The driveway is a pervious stone driveway that allows the water to drain directly into the ground.

(11) *Passive Design*

The basic form of the home is compact and linear along an East to West axis. This allows the utilization of the passive gain from the southern sun during the winter months and maximizes efficiency of the solar panels. The roof angle is a 10/12 slope for maximum solar access. The overhang extends out to two feet-six inches, ideal to shade the strong summer sun, yet allow for the winter sun to penetrate the interior.

(12) *HVAC System*

The Bridges, where this home is located, is the first total Geothermal Neighborhood in Nebraska. This means that each home is heated and cooled with help from the ground and/or water. The geothermal system requires no combustion process and stops the release of one ton of greenhouse gas. For each home on the water, there is a plate (4'x6' for this home) that will be submerged in the water. Each and every duct run and joint is sealed increasing the efficiency of the system. Air is supplied through the first floor trusses and none of the ductwork is located in the attic space.

(13) *Control System*

The whole-house control is a GE panel system and monitors the house function, located conveniently in the living room area. The system monitors the actual electrical usage of the home and the actual output of the photovoltaic panels at that moment and then can show daily, monthly or even yearly usage. The GE panel also keeps track of water usage all the way from watering the lawn to interior toilet and faucet usage.

THE MADISON

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THE MADISON

LINCOLN

1 Framing
The rafters are manufactured trusses with additional support added on site for the solar panels. The trusses have an 'energy heel' which allows the high insulation value to be continuous along the exterior walls. The 'flash and batt' method used in the attic gives a combined R-value of 57 to 64.

2 Roofing
The roofing material is made from a recycled product called EcoStar. The slate looking shingles are composed of 80% recycled post-industrial rubber and plastic. The rubber and plastic come from factory waste.

3 Renewable Energy
On the roof are 48 BP panels supplying the electricity for the 9kw system. Our home is grid-tied through Norris Public Power District (NPPD) with net metering. A Fronius grid tied inverter was used. If the system is producing more energy than needed, the meter itself runs backwards and sends the electricity to NPPD. If more energy is needed due to a cloudy day, then NPPD would provide the additional energy needed.

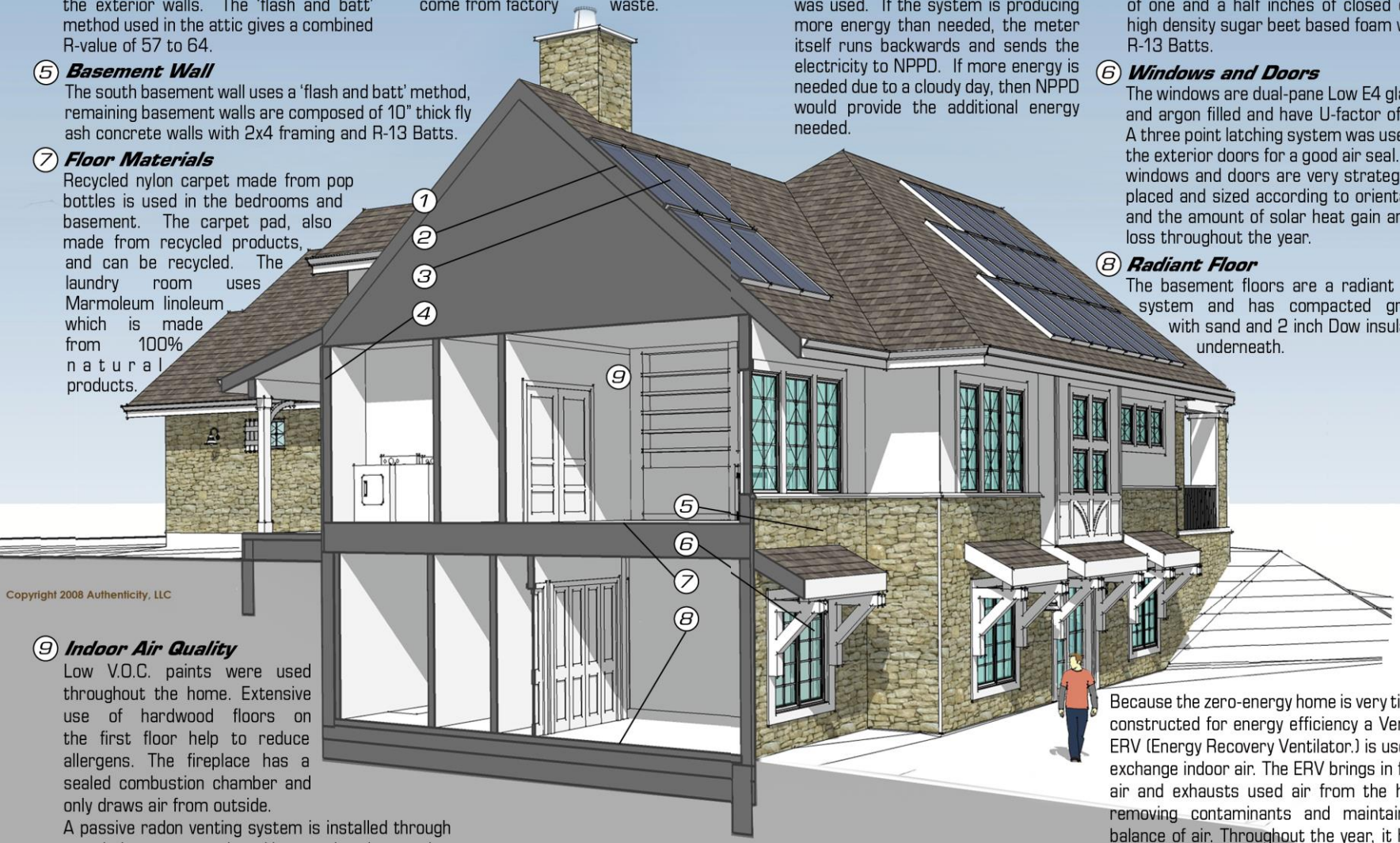
4 Wall Type
The walls were constructed with 2x6 studs at 16 inches on center allowing room for additional insulation. The 'flash and batt' method, allows an R-value from 23.5 to 27. This system is composed of one and a half inches of closed cell, high density sugar beet based foam with R-13 Batts.

5 Basement Wall
The south basement wall uses a 'flash and batt' method, remaining basement walls are composed of 10" thick fly ash concrete walls with 2x4 framing and R-13 Batts.

6 Windows and Doors
The windows are dual-pane Low E4 glazing and argon filled and have U-factor of .31. A three point latching system was used on the exterior doors for a good air seal. The windows and doors are very strategically placed and sized according to orientation and the amount of solar heat gain and loss throughout the year.

7 Floor Materials
Recycled nylon carpet made from pop bottles is used in the bedrooms and basement. The carpet pad, also made from recycled products, and can be recycled. The laundry room uses Marmoleum linoleum which is made from 100% natural products.

8 Radiant Floor
The basement floors are a radiant floor system and has compacted gravel, with sand and 2 inch Dow insulation underneath.



9 Indoor Air Quality
Low V.O.C. paints were used throughout the home. Extensive use of hardwood floors on the first floor help to reduce allergens. The fireplace has a sealed combustion chamber and only draws air from outside.
A passive radon venting system is installed through a sealed sump pump pit and is vented to the exterior.

Because the zero-energy home is very tightly constructed for energy efficiency a Venmar ERV (Energy Recovery Ventilator.) is used to exchange indoor air. The ERV brings in fresh air and exhausts used air from the home removing contaminants and maintains a balance of air. Throughout the year, it helps to regulate the humidity and temperature.

University of Nebraska Lincoln

ZNETH

OMAHA

Situated east of the Peter Kiewit Institute in Omaha, NE is a 1,800 square foot home known as the Zero net Energy Test Home or ZNETH.

ZNETH project's goal is project to produce more energy than it consumes. Solar collection devices located on the roof allow the ZNETH project to collect soalr energy and convert it to electricity. A Geothermal system harnesses the earth's temperature to be used for heating and cooling during the respective months, and a wind turbine will be used to exchange Nebraska's windy conditions into energy.

PARTNERS

- Airlite Plastics/Fox Blocks
- Aksarben Heating & Cooling, Inc.
- Andersen Windows/ Millard Lumber
- Carrell & Associates, Inc.
- Carroll Distributing & Construction Supply, Inc.
- CJ&T Lighting
- CM's Custom Lawn & Landscape
- Control Management, Inc.
- DK&B Construction Specialties
- Double D Excavating
- Green Team Geothermal
- The Gutter Company
- Hensel Richards Constructors, Inc.
- Hotz Concrete Pumping
- Hydro Pump Co. – HVAC
- J&T Plumbing & Sons
- KPE Consulting Engineers
- MJ Electric Corporation
- Nucor Building Systems
- phDesign, LLC
- OPPD
- Uponor, Inc.
- Werner Enterprizes, Inc.

10 Energy Management

Using a real time monitoring system the ZNETH home will obtain information on how much energy is being consumed and produced. By utilizing Energy Star® appliances, low-flow shower heads and faucets, and dual-flush toilets conservation of water and electricity can be maintained without extra effort from the occupant.

11 Milestone Recycled Glass

Made from recycled glass and different resins makes it one of the greenest products on the market. Used in many different applications such as interior counter tops, tables, signs, window sills and even toilet partitions.

12 Bamboo Flooring

Bamboo flooring is extremely hard, highly moisture resistant, and a rapidly renewable material. Bamboo's advantage is that it matures to around 50 feet and can be harvested within 5 years and re-grows on the same plant.

13 Energy Recovery Ventilator

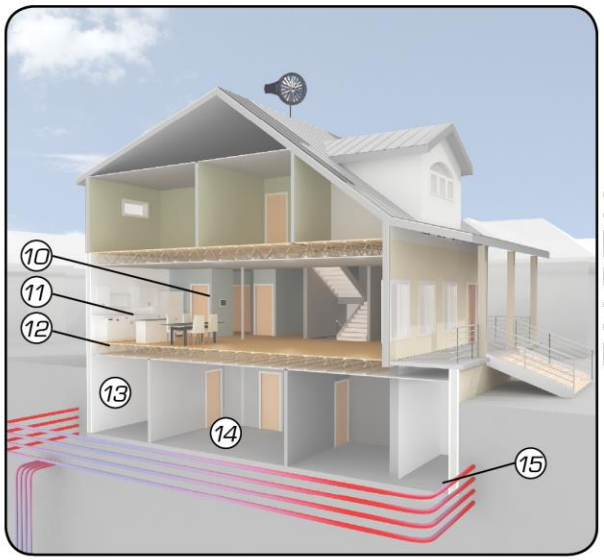
Capturing the exhausted building or space air and using it to precondition the incoming outdoor ventilation air is how an ERV meets ventilation & energy standards while improving indoor air quality, and reducing total HVAC equipment capacity. During the warmer seasons the system will pre-cool and dehumidify while humidifying and pre-heating in the cooler seasons.

14 Indoor Air Quality

V.O.C.'s, volatile organic compounds, are toxins found in interior materials. By using non-toxic finishes on all floors, walls, and cabinets these toxins are reduced. Using formaldehyde-free cabinet laminates and insulation helps to reduce the amount of off-gasing within the home. The absence of carpeting reduces indoor air particulates.

15 Geothermal Energy

A Geothermal heating and/or cooling system uses the earth's ability to store heat in the ground and/or thermal water sources.Two different loop orientations are installed, vertical and horizontal.



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ZNETH

zero net energy test house

OMAHA

① Honeywell Blade Tip Power Wind Turbine

This wind turbine has virtually no vibration, or friction due to the lack of ball bearings in the design. This helps to reduce energy loss during operation. The vertical orientation allows for the wind to be captured from any direction, including up and down.

② 1 Kw Photo-Voltaic Laminate Panels

PVLP's perform well in high temperature and low light conditions. The panels are light weight and flexible, weighing only one pound per square foot. The system adheres directly to flat surfaces without penetrations.

③ Standing Seem Steel Roof

The standing seam metal roof is weather tight and coated with a high reflective paint to reduce heat gain. The panels are installed with concealed clips which allow for thermal movement.

④ Porch Overhang

The porch overhang was specifically sized so that during the long hot summer months the southern face of the home will be in shade. While during the winter months the angle of the overhang allows for the sun to reach the southern wall to passively heat the home.

⑤ High Efficiency Doors and Windows

The use of air tight doors and windows allows for a HVAC system to operate at its highest efficiency. Windows are composed of double pane, argon filed, low-E coated glass with a U rating of 0.30

⑥ Insulated Concrete Forms

ICF wall system substantially improves the R-value of the walls. A standard 2x4 stud wall with batt insulation is R-11 compared to the ICF R-24. The permanent performance of the ICF wall system will not degrade over time due to the nature of materials. All materials used are non-toxic and stable in high moisture environments.

⑦ Site Strategies

Drought resistant native plants are used to conserve water on the site. Pervious paving materials are used on the steps and walkways. Permanent erosion control is achieved with a water garden.

The two underground cisterns collect rain water used to water the garden and landscape.

⑧ Infill Development

Building in a greater density existing urban neighborhood saves and prevents development of native and agricultural lands.

An ENERGY STAR® Version 2 Qualified Home

This home built at

6454 Woolworth Ave., Omaha, NE

by Unversity of Neb. Lincoln
has been verified by Omaha Public Power District, an independent professional or organization,
to meet or exceed strict energy efficiency guidelines
set by the U.S. Environmental Protection Agency.

HERS Index: 38

05/13/2011

Sam Rashkin
National Director
ENERGY STAR for Homes

www.energystar.gov

REM/Rate - Residential Energy Analysis and Rating Software v12.94

University of Nebraska Lincoln

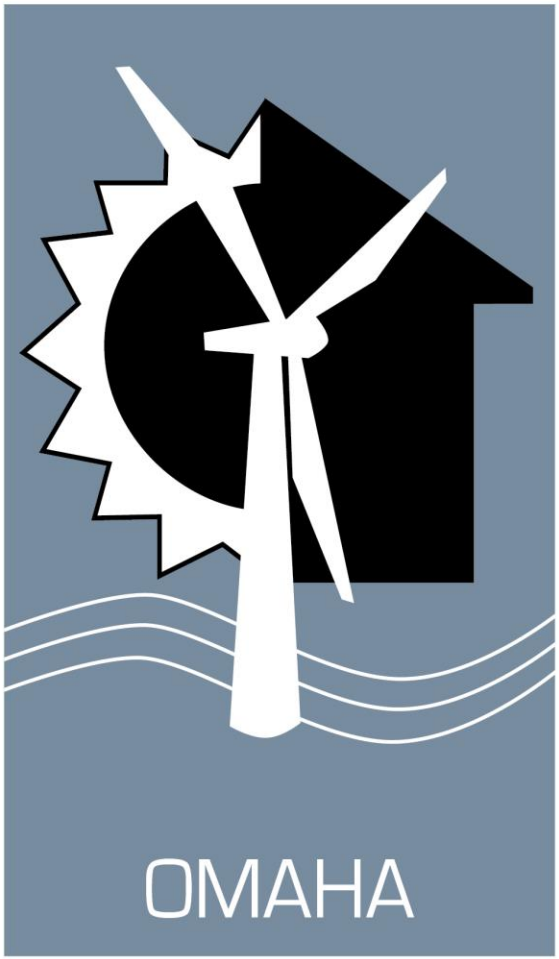
ALBRIGHT PLUS

OMAHA

The ALBRIGHT PLUS is a single-family residential single story home with conditioned basement and attached unconditioned garage. The foundation is cast in place concrete and 2x6 framed exterior wall, wood truss roof, with ducts located in wood floor trusses. It is situated in a cold climate. A cold climate is generally defined as a region with approximately 5,400 heating degree days (65°F basis) or more and fewer than approximately 9,000 heating degree days (65°F basis).

Hearthstone Homes has discontinued this particular house model used in research with the University of Nebraska. All Hearthstone Homes are ENERGY STAR qualified, achieving HERS index ratings in the mid to low 50s meaning they are 50% more energy efficient that a home of comparable size. The HERS index is a scoring system, the lower the HERS index the more energy efficient. A score of 0 would be a zero-net energy home.

HEARTHSTONE HOMES™



10 Sealing Attic Access Panel

The access to the attic is built up to provide a retaining barrier against the full depth of blown attic insulation. The access panel is installed in a frame made with trim casing.

11 Sealing Drywall

A continuous bead of glue is installed at the return air and top and bottom plates to ensure an air seal throughout the home.

12 Foam Draft Stops in Garage

Draft stops are installed and insulated in the garage ceiling at the wall line when there is living space above.

13 Foam all Sills and Rim Joist

Insulating spray foam is applied from the top few inches of the foundation wall, across the sill and continued up to the top of the intersection of the rim joist and the subfloor above.

14 Blow Duct Drop in Garage Full

The unconditioned garage is insulated by loose fill insulation above the soffit area to provide protection for the supply and return air trunk lines.

15 Seal Wall Framing

Joints in wall framing are a source of air infiltration, to mitigate this between the wall framing and subfloor, panel joints, and corners. Pure silicon caulking has proven the best sealant.

16 95% Efficient Furnace

The Energy Star qualified Trane XR95 single stage furnace features a 95% AFUE rating.

17 Decrease Equipment Sizing

Heating and air conditioning equipment is sized in accordance with ACCA Manual J or other approved heating and cooling calculation methodologies. Ductwork is made substantially airtight and leak free and insulated when necessary.

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ALBRIGHT PLUS

OMAHA

1 Roof Insulation
Loose fill insulation is blown into the attic at a uniform depth (approx. 17") to achieve an R-50 insulation factor.

2 Wall Insulation
Bibs is a blown in wall insulation system where a netting is tightly stapled to the interior face of the studs. This allows the blown in installation of loose fill insulation into the stud space between the exterior sheathing and the interior netting.

3 Garage Ceiling
Garage ceilings below a living space designed with a conditioned space below the second story floor. The bo of the floor truss is insulated wit R-30 fiberglass batt stapled to bottom of the truss cord.

4 Stairway Foam
Rigid, foil-faced Styrofoam is ap to the foundation wall below s and landings where irregular sp and reduced clearances are pre Styrofoam, 1-1/2"-2" thick, is installe needed to meet the required insul value.

5 High Efficiency Windows
Windows have a ¾" double pane glazing with solar cooling optimized low-E with argon gas fill for high performance. The spacer between glazing and frame is upgraded to provide a "warm edge".

6 Insulation Encapsulation
To achieve the best performance from wall insulation, it is important the insulation is encapsulated on all six sides to prevent air infiltration on all walls between conditioned and unconditioned space.

7 Finished Basement Wall
The optional finished or partial finished basement wall is a 2 x 4 wall with 2 x 6 plates placed inside the foundation walls. The stud cavities are filled with kraft-faced R-19 fiberglass insulation.

8 Insulation at Slab Edge
Homes with the optional walk-out basement are installed with a 2' section of R-10 rigid foam insulation on the inside face of the footing. The foam insulation extends from the top of the footing downward for 2'.

9 Blanket Insulation
Unfinished basement walls are insulated with a light density fibrous blanket laminated with a vinyl facing with an R-19 rating. This product has a superior thermal performance, is noncombustible, fire-rated and lightweight and covers the wall from the sill plate to the concrete floor.

Best Practices

- Describes energy efficient gains from 20 best practices
  - Albright model for cost and energy savings
    - mid-range
    - 1,497 square feet
    - single story
    - three bedrooms
    - two baths
    - Kitchen
    - great room
    - kitchen nook
- Identify technical requirements of best practices
- Describe application in design and construction of ZNETH II

Air Barriers

Description	Cost
Sealing Attic Access Panel	Less than $50
Sealing Drywall at Return Air and Top and Bottom Plate	$45.00-60.00
Foam Draft Stops in Garage	$2.00 – 2.25 per sq. ft. of house.
Foam all Sills and Rim Joist	$1.25 per square foot of house
Blow Duct Drop in Garage Full	$125.00-150.00 per duct drop
Seal Wall Framing	Less than $50
Seal Wall Framing	$80 - $130 per house

Insulation

Description	Cost
Stairway Foam	$122.00
Wall Panels 2 X 6 at 24” oc	$.50 per sq. ft. of house
Blown in Cantilevers	$.85-1.00 per square foot of house.
Garage Ceiling (vs. R-19)	$.65-.75 per square foot of house.
Finished Basement Wall	$.50 per square foot of surface area.
Insulation at Slab Edge	$85.00-$125.00
Insulation Encapsulation	$130-155 per house
R-50 Attic	$.75 to $.85 per square foot
Bibs Insulation	$.85-1.00 per square foot of house
Blanket Insulation Below Grade	$0.60-$0.65 per square foot of house
High Efficiency Windows	$7.25-$9.00 per square foot of glazing and $25.00 for installation per window.

System Solutions

Description	Cost
95% Efficient Furnace	Average $850.00 above 80% AFUE furnace
Deduct Existing Louver Door	($135.00)
Decrease Equipment Sizing	($150-300)

Expected Performance of Nine Models

Model	2000 IECC			2006 IECC			Current Best Practices		
	Therm	kWh	MMBtu	Therm	kWh	MMBtu	Therm	kWh	MMBtu
Alder	909	12,544	133.7	755	18,317	138	706	11,864	111.2
Albright	931	13,438	138.9	750	18,910	139.5	689	13,399	114.6
Alexandria	665	7,294	91.4	508	12,056	91.9	533	8,089	80.8
Cezanne	1,063	16,066	161.1	842	22,217	160	784	14,485	127.9
Redmond	1,059	14,605	155.7	984	21,747	172.5	905	14,882	141.2
Rembrandt	1,534	18,817	217.6	1,495	25,243	235.6	1,192	17,390	178.5
Roseland	844	8,061	111.9	813	10,869	118.4	702	7,282	95.0
Sanford	770	6,135	97.9	719	8,987	102.5	673	6,647	89.9
Whistler	1,158	17,119	174.5	1,084	24,829	193.1	953	16,943	153.2

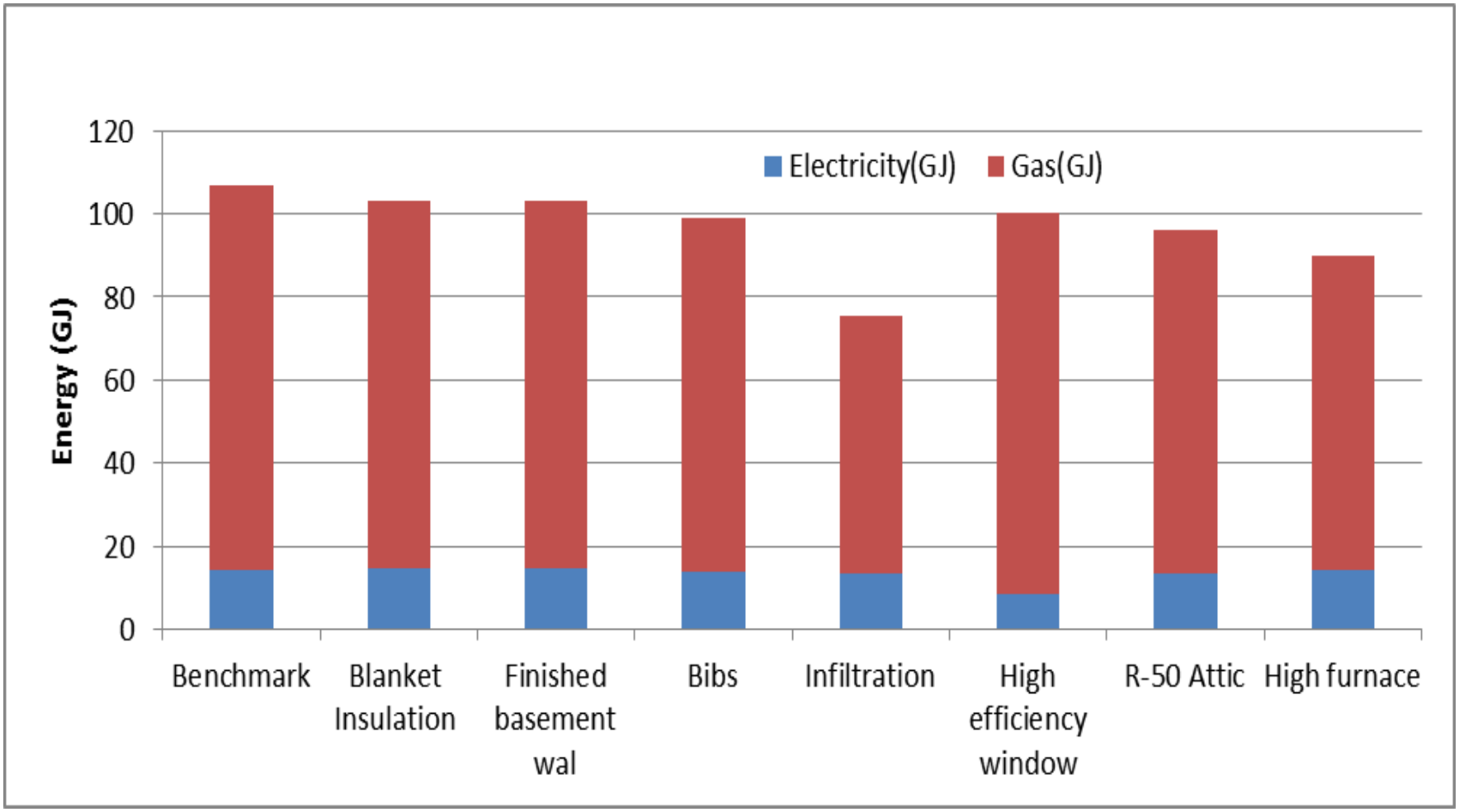
Energy Savings per Bundled Best Practice

	Elect. (GJ)	Gas(GJ)	Total(GJ)	Descrease%	Decrease (GJ)
Benchmark	14.25	92.54	106.79	0.00%	0.00
Infiltration	13.49	62	75.49	29.31%	31.30
Blanket Insulation	14.61	88.72	103.33	3.24%	3.46
Finished basement wall	14.49	88.54	103.03	3.52%	3.76
Bibs	13.95	85.24	99.19	7.12%	7.60
High efficiency window	8.47	91.73	100.2	6.17%	6.59
R-50 Attic	13.57	82.56	96.13	9.98%	10.66
High furnace	14.13	75.98	90.11	15.62%	16.68

Cost Savings per Bundled Best Practice

Name		J	F	M	A	M	J	J	A	S	O	N	D	Sum	Saving
Benchmark	E	82	73	74	72	89	161	203	187	141	87	69	79	1316	
	G	115	98	59	28	10	4	31	3	4	15	42	98	480	
High efficiency window	E	75	68	70	66	73	125	161	152	114	75	66	73	1117	$198
	G	109	97	64	32	12	4	3	3	4	14	42	92	476	$4
High furnace	E	82	73	74	72	89	161	203	187	141	87	69	79	1316	$0
	G	96	81	49	24	9	4	3	3	4	13	35	82	403	$77
R-50 Attic	E	80	71	73	71	87	156	196	182	140	87	68	77	1290	$25
	G	104	89	54	26	9	4	3	3	4	12	36	88	434	$46
Blanket Insulation below grade	E	81	72	74	72	90	166	207	188	141	87	69	79	1328	-$12
	G	112	94	55	25	9	4	3	3	4	15	42	97	462	$18
Finished basement wall	E	81	72	74	72	90	164	206	188	141	87	69	79	1324	-$9
	G	111	94	55	25	9	4	3	3	4	15	41	96	461	$19
infiltration	E	79	71	73	72	89	153	192	178	142	89	69	77	1285	$30
	G	82	69	42	19	7	4	3	3	4	9	27	70	338	$142
BIBS	E	81	72	73	71	88	159	200	185	141	88	69	78	1305	$10
	G	108	92	55	26	9	4	3	3	4	13	38	91	446	$34

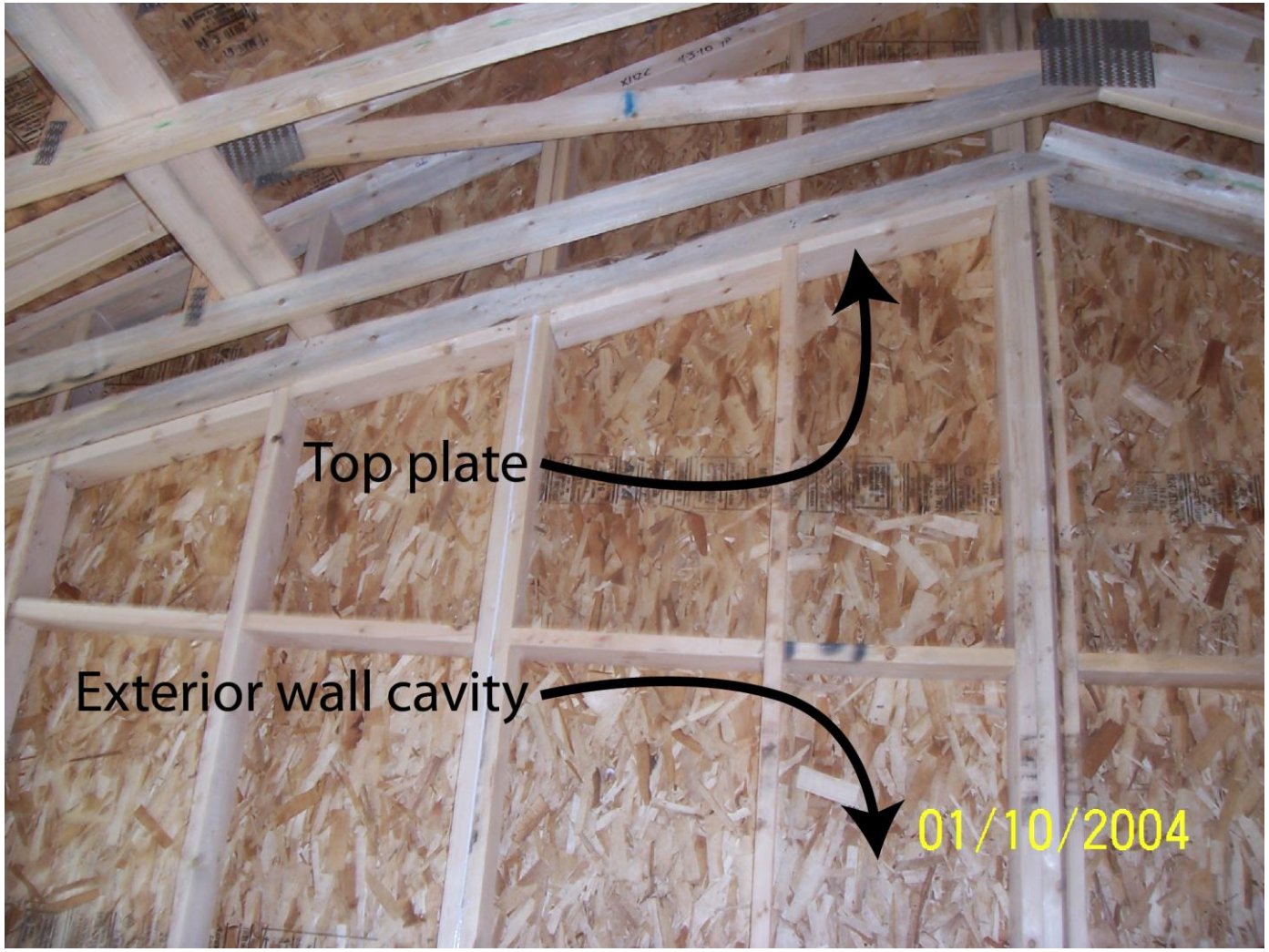
Energy Consumption vs. Best Practice



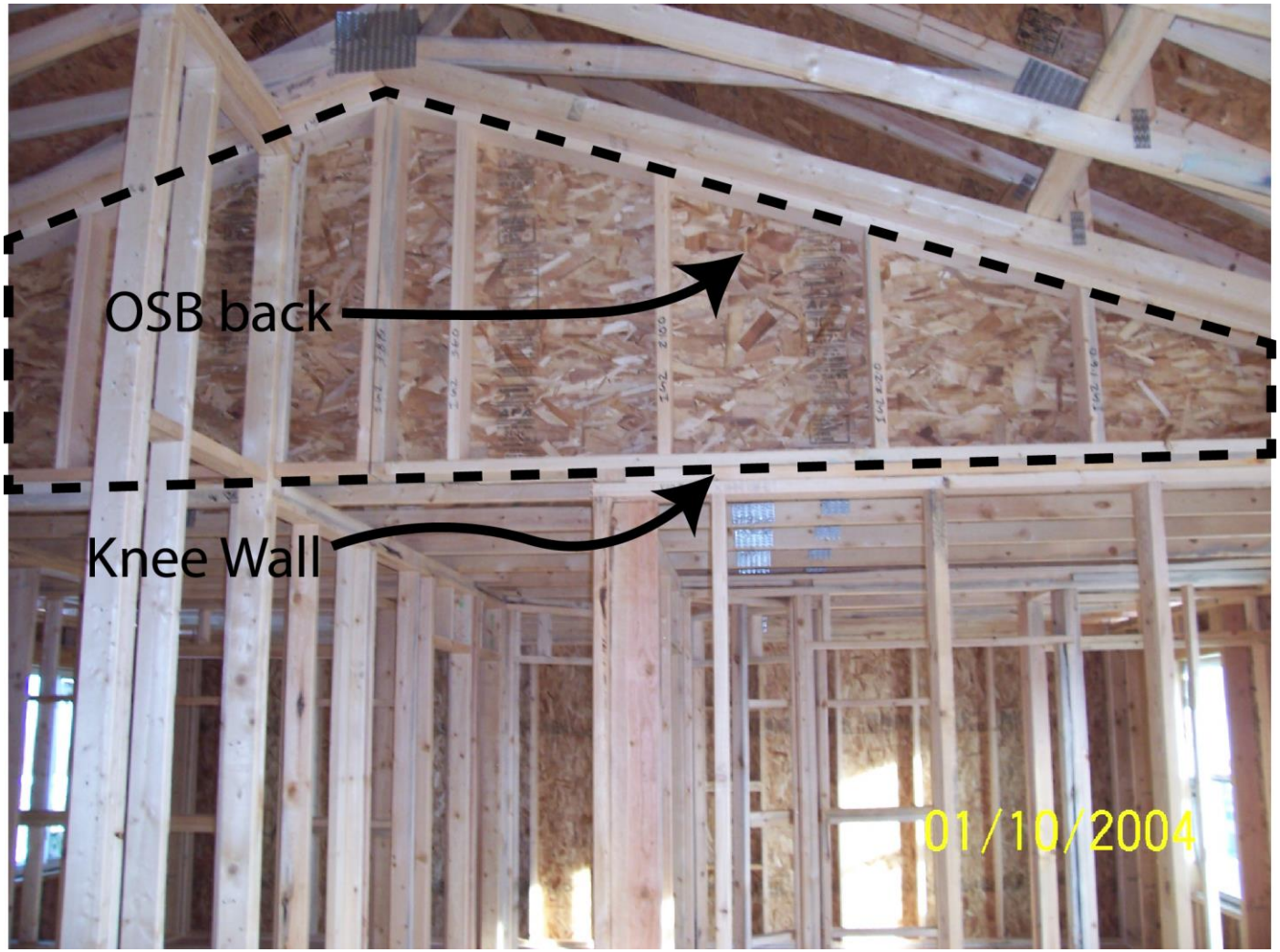
Framing Techniques

- Best Practices
  - Panelized Construction
  - Detailed for Insulation

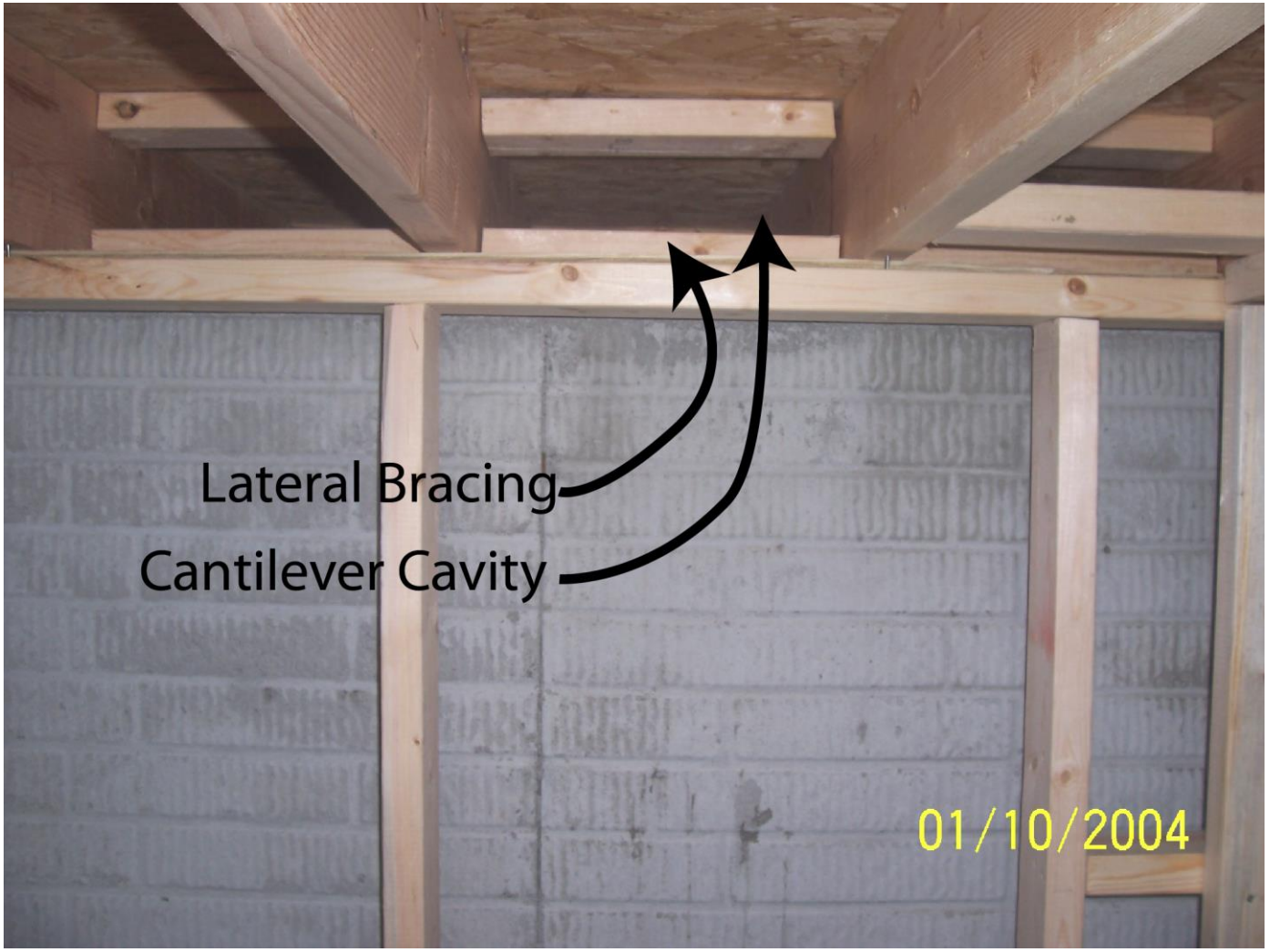
Framing Practices



Framing Practices



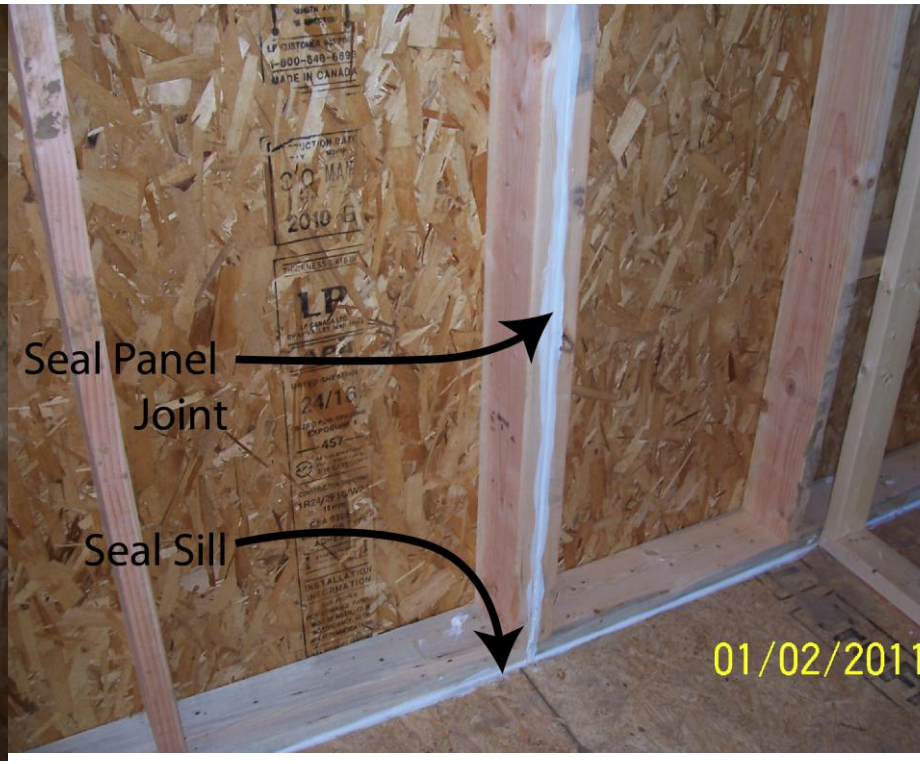
Framing Practices



Air Barrier

- Best Practices
  - Right type of sealant
  - Visible to inspection
  - Continuous across envelope

Air Barrier

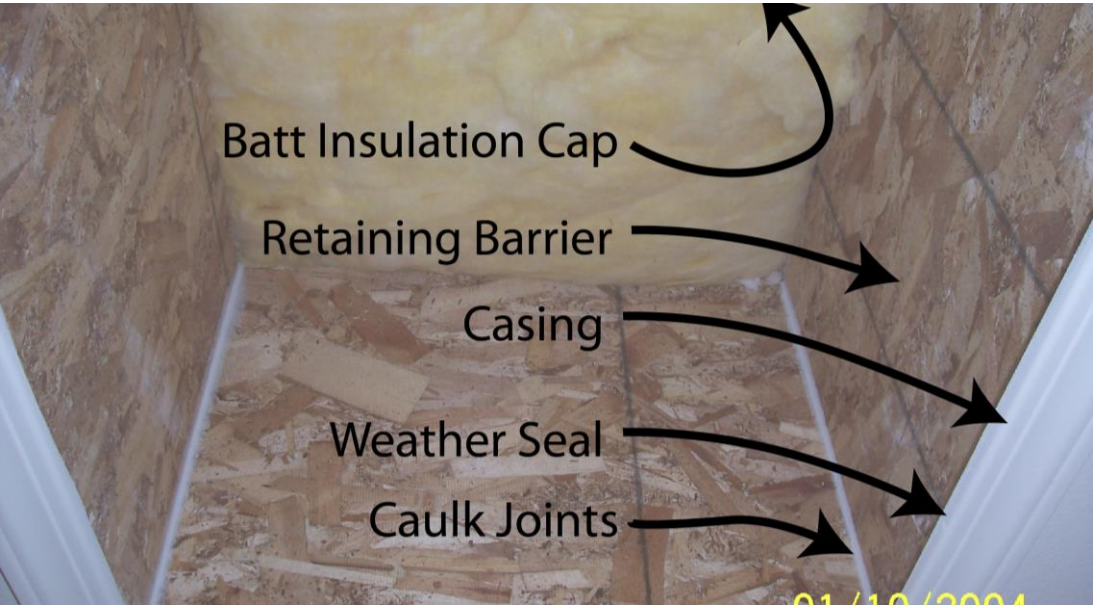


Air Barrier


Spray foam at sill
01/10/2004


Spray foam at rim joist
01/10/2004

Air Barrier

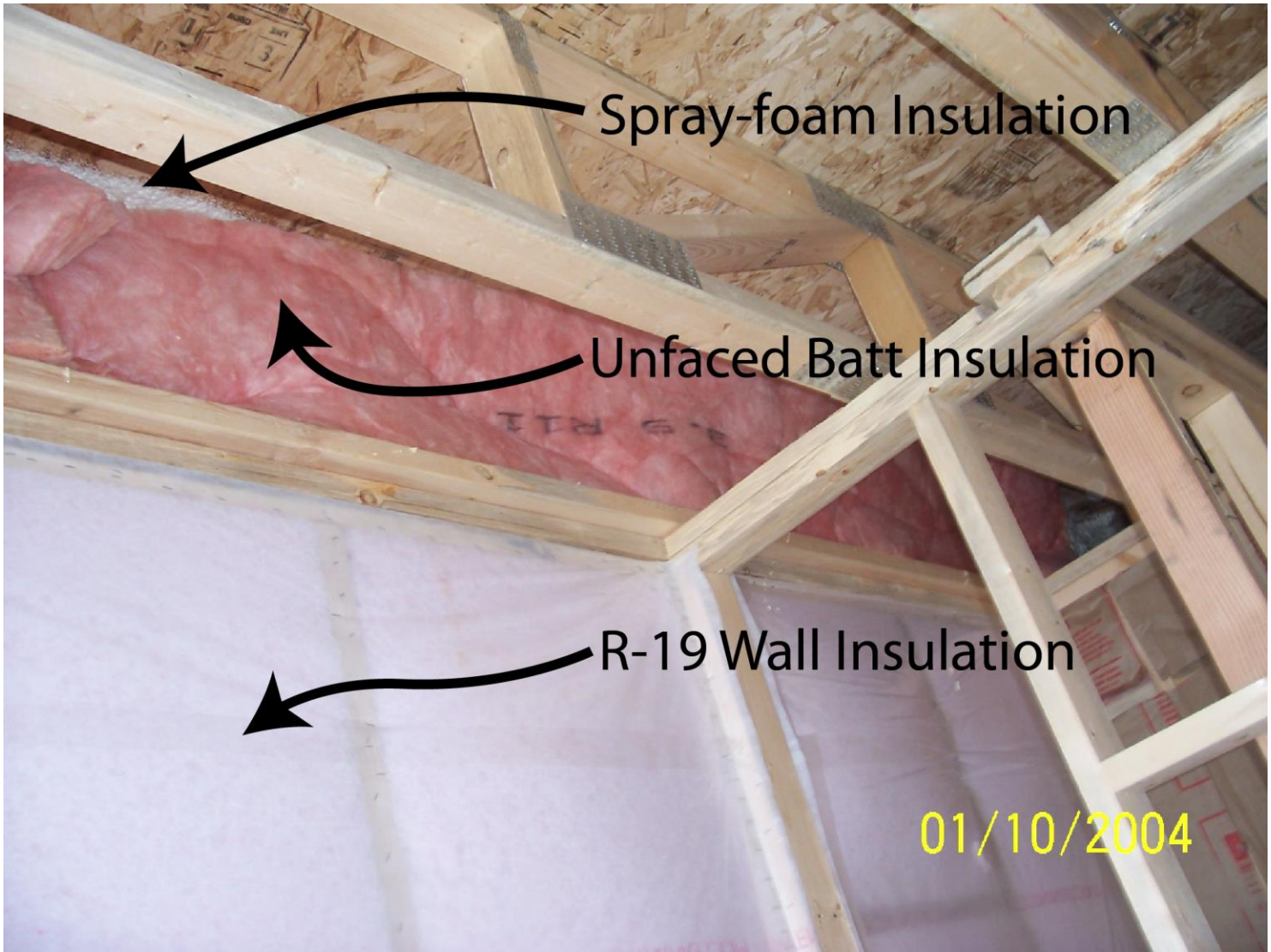

Batt Insulation Cap
Retaining Barrier
Casing
Weather Seal
Caulk Joints

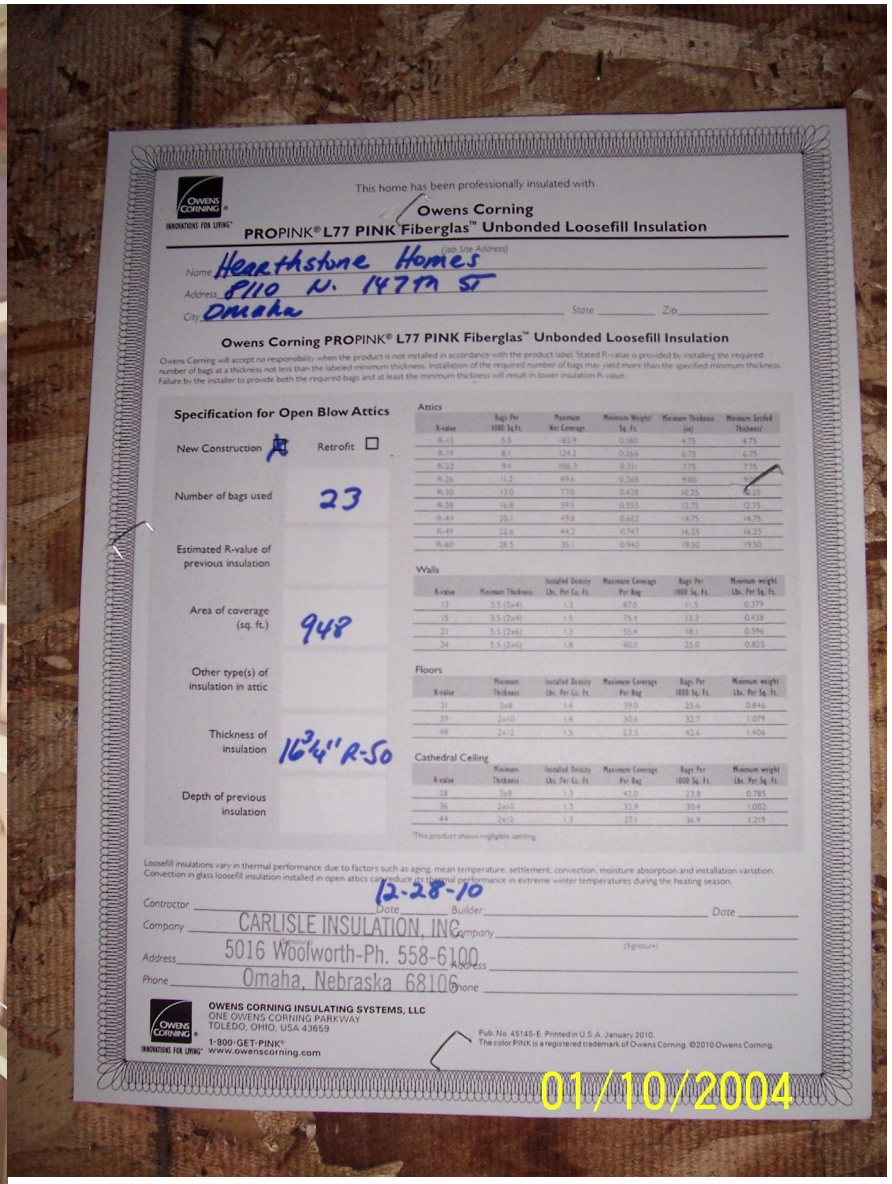

Access Panel
Weather Seal
Casing
01/10/2004

Insulation

- Best Practices
  - Continuous Rvalue
  - Encapsulated

Insulation


Spray-foam Insulation
Unfaced Batt Insulation
R-19 Wall Insulation
01/10/2004



This home has been professionally insulated with

Owens Corning

PROPINK® L77 PINK Fiberglas™ Unbonded Loosefill Insulation

(Job Site Address)

Name Hearthstone Homes

Address 8110 N. 147TH ST

City Omaha State Zip

Owens Corning PROPINK® L77 PINK Fiberglas™ Unbonded Loosefill Insulation

Owens Corning will accept no responsibility when the product is not installed in accordance with the product label. Stated R-value is provided by installing the required number of bags at a thickness not less than the labeled minimum thickness. Installation of the required number of bags may yield more than the specified minimum thickness. Failure by the installer to provide both the required bags and at least the minimum thickness will result in lower insulation R-value.

Specification for Open Blow Attics

New Construction ☑ Retrofit ☐	
Number of bags used	23
Estimated R-value of previous insulation	
Area of coverage (sq. ft.)	948
Other type(s) of insulation in attic	
Thickness of insulation	16¾" R-50
Depth of previous insulation	

Attics

R-value	Bags Per 1000 Sq.Ft.	Maximum Net Coverage	Minimum Weight/ Sq. Ft.	Minimum Thickness (in)	Minimum Settled Thickness*
R-13	5.5	182.9	0.180	4.75	4.75
R-19	8.1	124.2	0.266	6.75	6.75
R-22	9.4	106.3	0.311	7.75	7.75
R-26	11.2	89.6	0.368	9.00	9.00
R-30	13.0	77.0	0.428	10.25	10.25
R-38	16.8	59.5	0.555	12.75	12.75
R-44	20.1	49.8	0.662	14.75	14.75
R-49	22.6	44.2	0.747	16.25	16.25
R-60	28.5	35.1	0.940	19.50	19.50

Walls

R-value	Minimum Thickness	Installed Density Lbs. Per Cu. Ft.	Maximum Coverage Per Bag	Bags Per 1000 Sq. Ft.	Minimum weight Lbs. Per Sq. Ft.
13	3.5 (2x4)	1.3	87.0	11.5	0.379
15	3.5 (2x4)	1.5	75.4	13.3	0.438
21	5.5 (2x6)	1.3	55.4	18.1	0.596
24	5.5 (2x6)	1.8	40.0	25.0	0.825

Floors

R-value	Minimum Thickness	Installed Density Lbs. Per Cu. Ft.	Maximum Coverage Per Bag	Bags Per 1000 Sq. Ft.	Minimum weight Lbs. Per Sq. Ft.
31	2x8	1.4	39.0	25.6	0.846
39	2x10	1.4	30.6	32.7	1.079
48	2x12	1.5	23.5	42.6	1.406

Cathedral Ceiling

R-value	Minimum Thickness	Installed Density Lbs. Per Cu. Ft.	Maximum Coverage Per Bag	Bags Per 1000 Sq. Ft.	Minimum weight Lbs. Per Sq. Ft.
28	2x8	1.3	42.0	23.8	0.785
36	2x10	1.3	32.9	30.4	1.002
44	2x12	1.3	27.1	36.9	1.219

*This product shows negligible settling.

Loosefill insulations vary in thermal performance due to factors such as aging, mean temperature, settlement, convection, moisture absorption and installation variation. Convection in glass loosefill insulation installed in open attics can reduce actual thermal performance in extreme winter temperatures during the heating season.

Contractor Date 12-28-10 Builder Date

Company CARLISLE INSULATION, INC. Company

(Print or Type) (Signature)

Address 5016 Woolworth-Ph. 558-6100 Address

Phone Omaha, Nebraska 68106 Phone

OWENS CORNING INSULATING SYSTEMS, LLC
ONE OWENS CORNING PARKWAY
TOLEDO, OHIO, USA 43659
1-800-GET-PINK®
www.owenscorning.com

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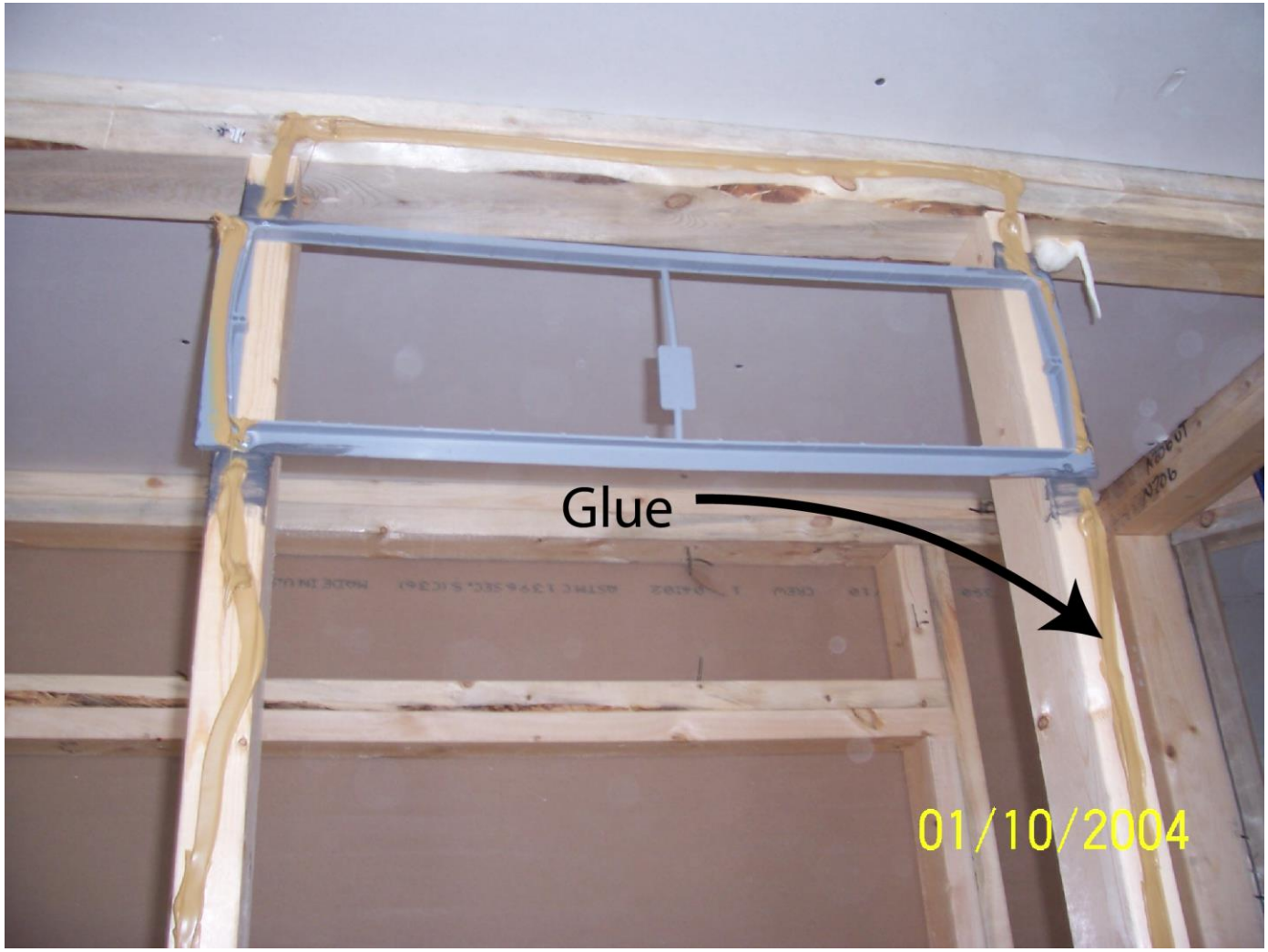
23
22
21
20
19
18
FIBER GLASS
LOOSEFILL
INSULATION
Insulation
Installation
01/10/2004

DOW
DOW
01/10/2004

Ductwork



ZNETH II

University of Nebraska Lincoln — OMAHA

Hummel Park

The ZNETH II project is a collaboration between the City of Omaha, Parks and Recreation and researchers at the University of Nebraska-Lincoln, Peter Kiewit Institute Technology Development Corp. A spokesperson for the Parks Department said, "This caretaker residence is a great public partnership between the educational/research component at the University of Nebraska and the recreation/summer camp activities in the City of Omaha. The 1,000 square foot, two-bedroom, one-bath home will serve as a research test facility for the University and will provide a caretaker residence for year-round occupancy at Hummel Park." The project research goal is to provide the optimal energy efficiency at little to no additional construction cost.

1 Ridge Vent
A ridge vent was installed to allow proper attic ventilation. During summer months outside air flows through the soffit vents and exits the ridge vent. The airflow through the attic helps balance the temperature and moisture.

2 Minimal Roof Penetrations
Roof penetrations can be minimized by the use of ventless plumbing techniques, such as air admittance valves, side-wall vents and direct vented appliances. By removing penetrations, heat loss can be reduced and water leaks minimized.

3 Hardiplank Siding
Hardiplank siding is a fiber-cement siding composed of cellulose fibers and cement-like material. The siding is extremely durable, sustainable and fire resistant. If installed and maintained properly, Hardiplank siding can provide an airtight barrier lasting over fifty years.

4 High Efficiency Doors and Windows
The use of energy efficient windows allows for the mechanical ventilation system to operate at its best efficiency. High efficiency windows are made from two layers of glass, instead of one, separated by insulating gas and coated with a special material to selectively filter sunlight. The windows are twice as efficient as a normal window and specifically placed based on site orientation to maximize performance.

5 Water Conservation
Water is captured and recycled on site through the use of rain barrels.

6 Roof Truss with Energy Heel
An energy heel lifts the roof truss up at the eave to allow for additional insulation in the attic. Typical roof trusses narrow to 6" at the eave reducing the amount of space and limiting the insulations effectiveness. The energy heel increases the truss depth 14" allowing more insulation and eliminating cold spots along the roofline.

7 Double 2x4 Stud Wall
Double wall framing allows thermal isolation between the inner and outer walls as well as eliminating the thermal bridging and air-barrier interruption of the floor deck. Using this technique along the insulation the exterior walls are two times more effective than a typical wall.

8 LED Lighting
Use of LED lighting throughout the building allows for lower energy consumption.

9 Whole House Energy Monitoring & Control System
Using a real time monitoring system the ZNETH II home will obtain information on how much energy is being consumed and produced. Energy Star appliances, low-flow showerhead, toilet and faucet conserve energy and water.

10 Geothermal Heat Pump
A 2-ton geothermal heat pump is installed in the home with a two-stage variable furnace blower, 5kw backup heat and 6" fresh air intake. The system uses the earth's constant temperature as the heat source or sink to provide warm or cool air. Due to the home's air-tight construction, the fresh air intake mechanically provides outdoor air to keep the home healthy.

11 Attic Insulation
Loose fill insulation is blown into the attic to a uniform depth of 18" and achieves an insulation factor one and a half times better than normal.

PARTNERS AND TEAM

University of Nebraska Lincoln | Nebraska Center for Energy Sciences Research

City of Omaha, Nebraska

The Nebraska Environmental Trust

Nebraska Engineering

HearthStone Homes™

Nebraska Architecture

The Peter Kiewit Institute

Timi Hemsath, AIA
Assistant Professor College of Architecture
University of Nebraska-Lincoln

James Goddart, PhD, PE
Interim Director for Research and Industry Outreach Peter Kiewit Institute
University of Nebraska - Omaha


Nebraska
Zero-Net Energy Test House
ZNETH II


PHILIPS
PHILIPS
PHILIPS
PHILIPS
PHILIPS
PHILIPS
LED
40
75
AmbientLED
WHITE LIGHT WHEN LIT
$96


23
22
21
20
FIBER GLASS
LOOSEFILL
INSULATION

Modifications

- Best Practices
  - Exterior Attic Access
  - Penetrations through wall
  - Energy Heal Truss
  - Double Wall Construction
  - Geothermal
  - LED lights

ZNETH II

OMAHA

The ZNETH II project is collaboration between the City of Omaha, Parks and Recreation and researchers at the University of Nebraska-Lincoln, Peter Kiewit Institute Technology Development Corp. Director of Parks, Recreation and Public Property, Melinda Pearson, said, "This caretaker residence is a great public partnership between the educational/ research component at the University of Nebraska and the recreation/summer camp activities in the City of Omaha. The 1,000 square foot, two-bedroom, one-bath home will serve as a research test facility for the University and will provide a caretaker residence for year-round occupancy at Hummel Park." The project research goal is to provide the optimal energy efficiency at little to no additional construction cost.

OMAHA

⑤ *Whole House Energy Monitoring & Control System*

Using a real time monitoring system the ZNETH II home will obtain information on how much energy is being consumed and produced. Energy Star appliances, low-flow shower head, toilet and faucet conserve energy and water.

⑥ *R-50 Attic*

Loose fill insulation is blown into the attic at a uniform depth (approx. 17") to achieve an R-50 insulation factor.

⑦ *Roof truss with energy heel*

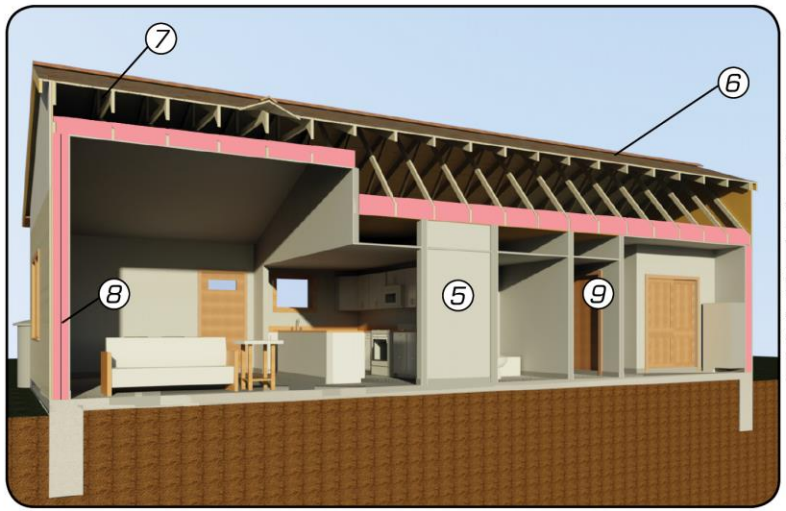
An energy heel lifts the roof to allow for additional insulation in the attic. Typical roof trusses narrow to 6" in thickness at the eave where the roof line meets the outer wall. As the roof gets narrower the effectiveness of the insulation is reduced due to less space. The advantage of including an Energy Heel in the roof trusses is it allows 14" of insulation versus the standard 6". This increases the R value of that area, and eliminates cold spots along the roof line.

⑧ *Double 2x4 studwall*

Double wall framing allows thermal isolation between inner and outer walls as well as eliminating the thermal bridging and air-barrier interruption of the floor deck. Using this technique along with insulation will achieve an R-30 value.

⑨ *Geothermal Heatpump*

Installed in the home is a 2 ton Geothermal heatpump, a two stage variable furnace blower combined with a hot water generator. A 5Kw backup heat and 6" fresh air intake. This system has an Energy Efficiency Rating of 26.



ZNETH II

NEBRASKA RESEARCH INITIATIVE FUNDING

Interdisciplinary Building Science Research Partners:

- University of Nebraska-Lincoln College of Architecture
- Department of Chemistry at the University of Nebraska-Omaha
- University of Nebraska-Lincoln College of Architectural Engineering and Construction
- University of Nebraska Medical Center College of Public Health

ZNETH II

ero et nergy est ouse

OMAHA

1 *Ridge Vent*
A ridge vent was installed to allow the attic proper ventilation. During the summer months outside air flows through the soffit vents and exits the ridge vent, which aids in keeping the temperature and moisture down in the attic.

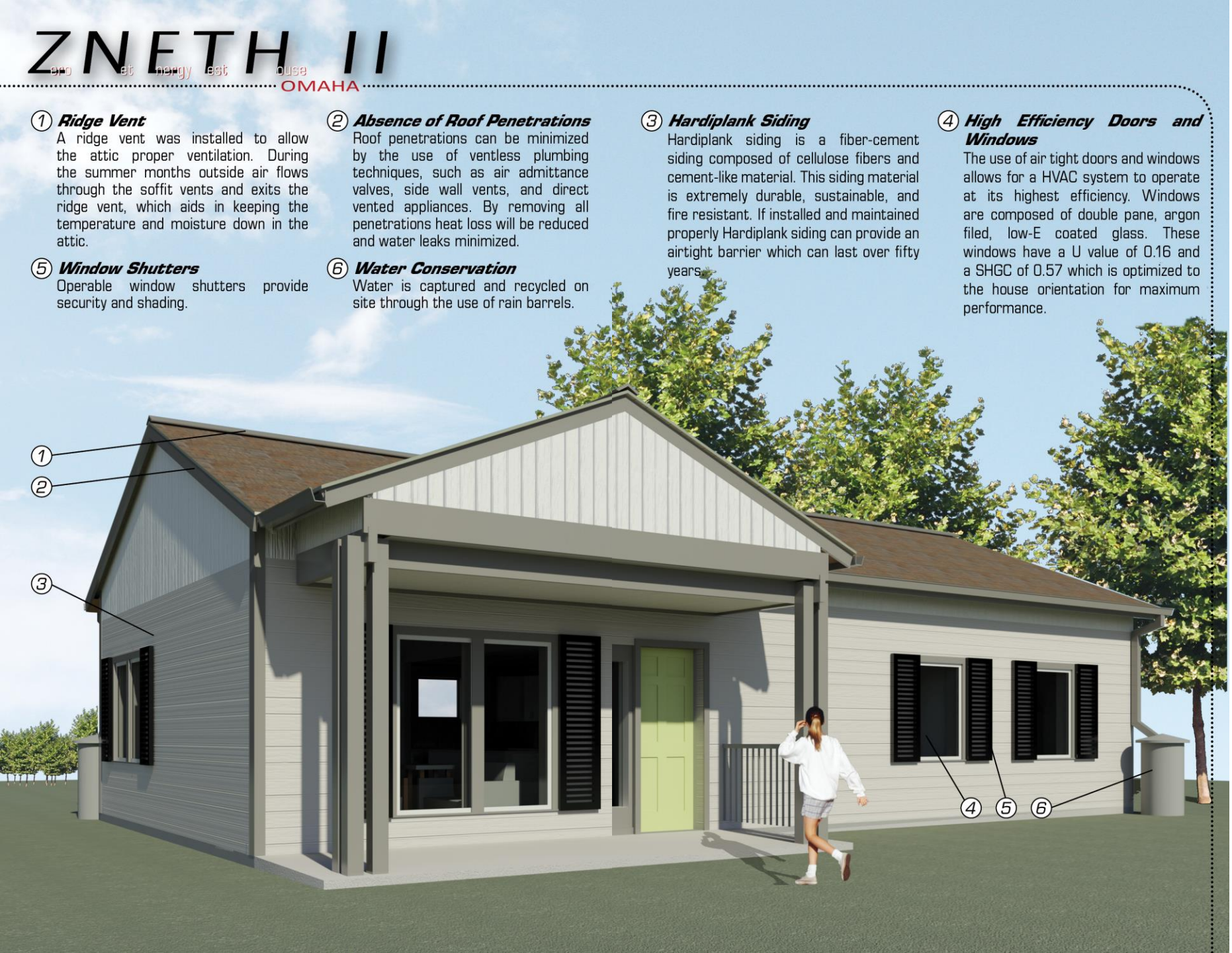
2 *Absence of Roof Penetrations*
Roof penetrations can be minimized by the use of ventless plumbing techniques, such as air admittance valves, side wall vents, and direct vented appliances. By removing all penetrations heat loss will be reduced and water leaks minimized.

3 *Hardiplank Siding*
Hardiplank siding is a fiber-cement siding composed of cellulose fibers and cement-like material. This siding material is extremely durable, sustainable, and fire resistant. If installed and maintained properly Hardiplank siding can provide an airtight barrier which can last over fifty years.

4 *High Efficiency Doors and Windows*
The use of air tight doors and windows allows for a HVAC system to operate at its highest efficiency. Windows are composed of double pane, argon filed, low-E coated glass. These windows have a U value of 0.16 and a SHGC of 0.57 which is optimized to the house orientation for maximum performance.

5 *Window Shutters*
Operable window shutters provide security and shading.

6 *Water Conservation*
Water is captured and recycled on site through the use of rain barrels.



Lessons Learned

- Best Practices
  - Client Expectations
  - Continuous Insulation
    - Headers, Wall penetrations, Underslab
  - Fire stops in exterior wall

ACSA / AIA Housing Research Lecture Series

Timothy L. Hemsath, AIA, LEED AP = prime contact
Assistant Professor, Architecture Program

College of Architecture

University of Nebraska-Lincoln

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