In accordance with the Department of Labor and Industry's statute 326.0981, Subd. 11,

"This educational offering is recognized by the Minnesota Department of Labor and Industry as satisfying **1.5 hours** of credit toward **Building Officials and Residential Contractors code /1 hour energy** continuing education requirements."

For additional continuing education approvals, please see your credit tracking card.

Zero Energy Ready Home: Are You Onboard? Why or Why Not?

Brian J. Wimmer

Two Rivers Habitat for Humanity®

Certified Professional Inspector — InterNACHI CPI

InterNACHI Certified — Moisture Intrusion Inspector

U.S. Department of Energy — Home Energy Score

Home Energy Auditor — InterNACHI Certified

Infrared certified

ZERO ENERGY READY HOME — U.S. Department of Energy

ZERH: What is it?

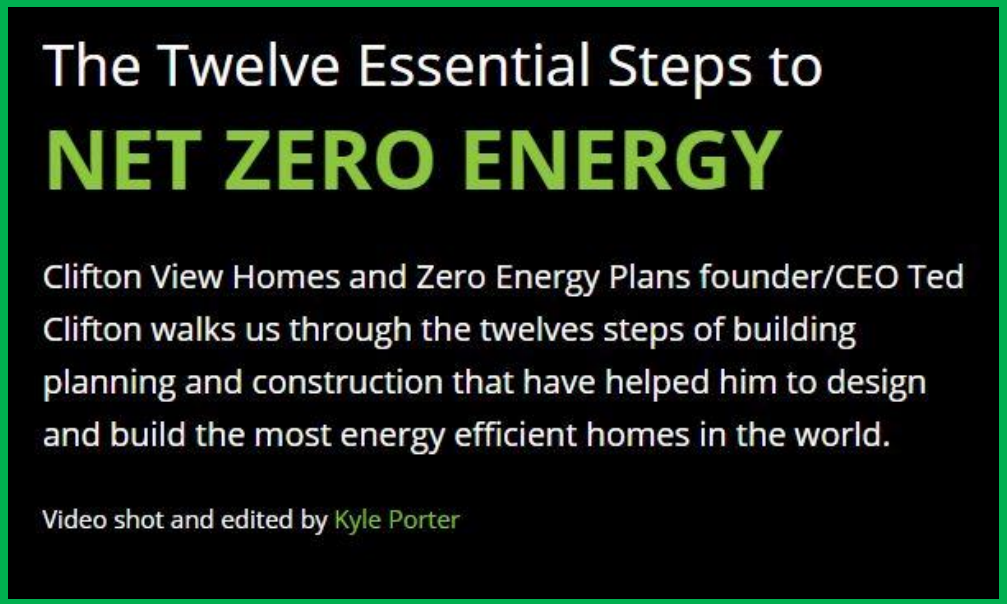
The DOE Zero Energy Ready Home

ZERO
ENERGY READY HOME
U.S. DEPARTMENT OF ENERGY

"A DOE Zero Energy Ready Home is a high performance home which is so energy efficient, that a renewable energy system can offset all or most of its annual energy consumption."

ZERH: What is it?

- The Twelve Essential Steps to Net Zero



ZERO ENERGY READY HOME
U.S. DEPARTMENT OF ENERGY

Zero Energy Ready Home: Homebuyers

https://youtu.be/sp6eJELZACI

DOE ZERH Requirements

DOE Zero Energy Ready Home
National Program Requirements (Rev. 06)
April 20, 2017

DOE ZERO ENERGY READY HOME REQUIREMENTS

DOE Zero Energy Ready Homes must meet all DOE Zero Energy Ready Home National Program Requirements (Rev.06) for homes permitted on or after 7/20/2017. Note that the Rev. 06 program requirements may also be used for projects permitted before 7/20/2017.

Homes permitted prior to 7/20/17, but on/after 8/11/2015, have the option of using the Rev.05 specifications. Homes permitted prior to 8/11/2015 have the option of using the Rev. 04 specifications.

DOE Zero Energy Ready Homes must:

- ✓ **1) Comply with ENERGY STAR for Homes Program Requirements and Inspection Checklists for:**
  - oThermal Enclosure
  - oHVAC Quality Installation (Contractor and HERS Rater)
    - •Exceptions for QA-Credentialed HVAC Contractor (December 2016)
    - •DOE Zero Energy Ready Home 'Hardship' Waiver (May 2018)
  - oWater Management
  - oThe target home/size adjustment factor used by ENERGY STAR
- ✓ **2) Feature energy efficient appliances and fixtures that are ENERGY STAR qualified.**
- ✓ **3) Use high-performance windows that meet ENERGY STAR v5.0 and v6.0 specifications (depending on climate zone).** The required U and Solar Heat Gain Coefficient (SHGC) values are shown below, effective 8/22/2016.

DOE ZERH Requirements

DOE Zero Energy Ready Home
National Program Requirements (Rev. 06)
April 20, 2017

	Hot Climates IECC CZ 1-2		Mixed Climates IECC CZ 3-4 except Marine		Cold Climates IECC CZ 5-8 and 4 Marine[2]	
	U-Value	SHGC	U-value	SHGC	U-Value	SHGC
ENERGY STAR Window Specs Required for DOE Zero Energy Ready Home Projects[1]	0.40	0.25	[CZ 3] 0.30 [CZ 4] 0.30	[CZ 3] 0.25 [CZ 4] 0.40	0.30 0.31 0.32	Any ≥0.35 ≥0.40

1. DOE Zero Energy Ready Home offers multiple compliance paths including area weighting and allowances for passive solar design. See the National Program Requirements, Exhibit 1 with footnotes, for details.

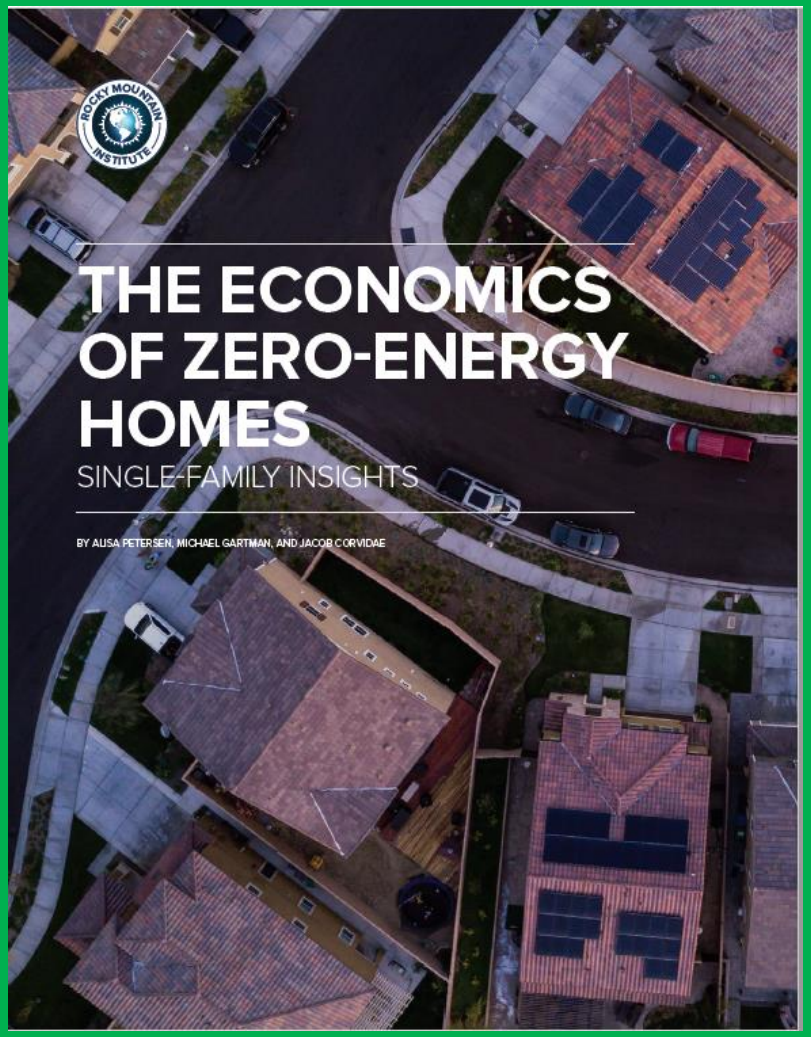
2. These U & SHGC values are based on the ENERGY STAR v5.0 Window Specifications. DOE ZERH will review the feasibility of adopting ENERGY STAR v6.0 Window Specifications, which entail lower U values, periodically. Any program update to require the v6.0 window specs will be announced with a minimum 1-year phase-in.

DOE ZERH Requirements

DOE ZERO ENERGY READY HOME REQUIREMENTS (cont.)

- ✓ **4) Meet 2012 International Energy Conservation Code levels for insulation**. In some states 2015 IECC insulation levels are required – see End Note #15 of the Rev.06 specs
- ✓ **5) Follow the latest proven research recommendations by installing ducts in conditioned space or in an optimized location as defined in the program specs.**
- ✓ **6) Conserve water and energy through an efficient hot water distribution system that provides rapid hot water to the homeowner.**
  Download the WaterSense Excel tool for estimating the stored volume in hot water distribution systems.
- ✓ **7) Provide comprehensive indoor air quality through full certification in EPA's Indoor airPlus Program**
- ✓ **8) Accomplish savings on the cost of future solar PV installations by following the PV-Ready checklistfor climates with significant solar insolation.** This checklist references EPA's solar electric guide. (Note that the solar-hot water provisions of the checklist are no longer mandatory and can be found below with encouraged items.)

Costs & Savings



Adobe Acrobat Document

Adobe Acrobat Document

Recent Studies/Successes

DOE Zero Energy Ready Home Savings & Cost Estimate Summary *October 2015*
October 2015

In terms of economic assumptions, energy rates used in this analysis were $0.11/kWh and $1.06/therm of natural gas. Monthly net cash flow calculations assumed a 30-year fixed rate mortgage with a 5% interest rate.

RESULTS

Table 1 below provides a summary of the HERS Index, energy savings, incremental costs for upgrades, and net monthly cash flow for the DOE Zero Energy Ready Home models compared to a 2009 IECC baseline home. Table 2 shows the same information for DOE Zero Energy Ready Home relative to a 2012 IECC baseline.

Table 2: DOE Zero Energy Ready Home Energy & Cost Comparison to 2012 IECC Baseline

Climate Zone	Space & Water Heating Energy Source	12 IECC - HERS Index	ZERH - HERS Index	Monthly Energy Cost Savings for ZERH House vs. 12 IECC House ($)	Estimated Marginal First Cost for ZERH House ($)	Amortized Marginal First Cost for ZERH House ($)	Net Monthly Cashflow ($)
3	ELECTRIC	74	57	$37	$4,663	$25	$12
3	GAS	72	54	$37	$4,216	$23	$14
5	ELECTRIC	61	53	$40	$4,403	$24	$16
5	GAS	59	49	$33	$3,896	$21	$12

Table 1: DOE Zero Energy Ready Home Energy & Cost Comparison to 2009 IECC Baseline

Climate Zone	Space & Water Heating Energy Source	09 IECC - HERS Index	ZERH - HERS Index	Monthly Energy Cost Savings for ZERH House vs. 09 IECC House ($)	Estimated Marginal First Cost for ZERH House ($)	Amortized Marginal First Cost for ZERH House ($)	Net Monthly Cashflow ($)
3	Electric	88	57	$66	$7,291	$39	$26
3	Gas	86	54	$66	$6,868	$37	$29
5	Electric	78	53	$101	$5,590	$30	$71
5	Gas	72	49	$70	$5,083	$27	$43

Costs & Savings Anology

Econo-Car	Luxury Car + 5%
No safety features	**Driver Assistance Features**
Air leaks	**Well-sealed doors**
Road noise	**Quiet Ride**
Poor defroster/heater	**Superior Heater/Defroster**
Cold spots in compartment	**Even Comfort Level**
Rust in 5 years	**30-year No Rust Warranty**

Item	Econo-Car	Luxury Car 5% More
Cost	$14,000.00	$14,700.00
Loan Pymt	$252.00	$264.60
MPG	30.00	40.00
Miles driven/yr	15,000.00	15,000.00
Total Gallons	500.00	375.00
Cost/Gallon $2.50	$1,250.00	$937.50
Per month	$104.17	$78.13
total Cost/Month	$356.17	$342.73
	Montly Savings=	**$13.44**
	Yearly Savings=	**$161.30**

Some of Our Results

Site Walk Report: Insulation (SV2)

Site Walk Date: 2011-02-16

File Number #3229 Building Code MN Code
Site Walk Date 2011-02-16

MINNESOTA ENERGY RESOURCES

Home
3062 Eastwood Rd SE
Rochester, MN 55904

Builder
Habitat for Humanity - Rochester Area
1530 Greenview Drive SW
Suite 107
Rochester, MN 55902

Model
Custom
Type: Single-family detached

Estimated HERS Index 65

Zero Energy Building (0) — American Standard Building (100)

RESNET Ratings provides a relative energy use index called the HERS Index, which represents the home's energy usage as a percentage of the energy usage of the "American Standard Building."

0 TBC Failures need correcting

4 Issues could use improvement

5 Exceptional building practices identified

Insulation Features	
Insulation Grade Level	II
Ceiling Flat	R = 44.0
Vaulted Ceiling	n/a
Above Grade Walls	R = 24.0
Foundation Walls	R = 22.0
Framed Floors	n/a
Slab	R = 22.0 Edge, 22.0 Under
Duct	Uninsulated
Window	U = 0.310, SHGC = 0.310

Heating and Cooling Plan	
Heating Type	Fuel-fired air distribution
Heating Fuel	Natural gas
Heating Efficiency (AFUE)	92.00
Cooling Fuel	Electric
Cooling SEER	13.00

Houserater Home ID #3229 XRG Concepts | Site Walk Date: 2011-02-16 page 1 of 8

Final Testing and Completion Report (SV3)

Site Walk Date: 2016-12-27

Building Code MN Code
File Number #66534
Site Walk Date 2016-12-27

Home
701 Blanch St
Mantorville, MN 55955

Builder
Habitat for Humanity - Rochester Area
1530 Greenview Drive SW
Suite 107
Rochester, MN 55902

Model
Production
Type: Single-family detached
Size: 1982 ft²

ENERGY STAR Requirements NO

Checklists Completed	Checklists Signed	Meets Testing Standards
No	No	Yes

HERS Index 45

Zero Energy Building (0) — American Standard Building (100)

RESNET Ratings provide a relative energy use index called the HERS Index, which represents the home's energy usage as a percentage of the energy usage of the "American Standard Building."

Beats 2006 IECC standard by 70.10%

0 TBC Failures need correcting

4 Issues could use improvement

0 Exceptional building practices identified

Insulation Features	
Worst Insulation Grade	III/NR
Rim	Grade: I
Ceiling Flat	R = 50.0 (Grade III/NR)
Vaulted Ceiling	n/a
Above Grade Walls	R = 28.0 (Grade I)
Foundation Walls	R = 23.0 (Grade I)
Framed Floors	n/a
Slab	R = 23.0 Edge, 23.0 Under (Grade III/NR)
Duct	Uninsulated
Window	U = 0.220, SHGC = 0.270

Blower Door Test Results	
Tested CFM50	310
CFM50 / ft² surface area	0.07
CFM50 / ft² floor area	0.16
ACH50	1.05

Ventilation Flow Test Results	
Target Flow (CFM)	Unknown
Actual Flow (CFM)	0
Rated Flow (CFM)	0.0
Duct Leakage to Outside	235

	Heat	Cooling	Hot Water	Ventilation	Thermostat
Efficiency	96.1 (AFUE)	(SEER)	0.66		
Brand / Make	Daikin	Not Installed	Bradford White	Venmar	Pro1
Model	DM96VE0402BNAB	N/A	RG1PV40S6N	Venmar	Pro1
Size	38.0 BTU	BTU	40 Gal		

Houserater Home ID #66534 XRG Concepts | Site Walk Date: 2016-12-27 page 1 of 4

Some of Our Results

XRG CONCEPTS

Final Testing and Completion Report (SV3)

Site Walk Date: 2013-01-23

Building Code	MN Code
File Number	#12726
Site Walk Date	2013-01-23

MINNESOTA ENERGY RESOURCES

Home	Builder	Model
1929 3rd Ave SW Rochester, MN 55902	Habitat for Humanity - Rochester Area 1530 Greenview Drive SW Suite 107 Rochester, MN 55902	Production Type: Single-family detached Size: 2078 ft²

ENERGY STAR Requirements NO

Checklists Completed	Checklists Signed	Meets Testing Standards
No	No	Yes

HERS Index 53

50 60 70 80 90

Zero Energy Building (0) — American Standard Building (100)

RESNET Ratings provide a relative energy use index called the HERS Index, which represents the home's energy usage as a percentage of the energy usage of the "American Standard Building."

Beats 2004 IECC standard by 69.44%

0 TBC Failures need correcting

0 Issues could use improvement

0 Exceptional building practices identified

Insulation Features

Worst Insulation Grade	III/NR
Rim	Grade: I
Ceiling Flat	R = 44.0 (Grade III/NR)
Vaulted Ceiling	n/a
Above Grade Walls	R = 24.0 (Grade II)
Foundation Walls	R = 22.0 (Grade I)
Framed Floors	n/a (Grade III/NR)
Slab	R = 22.0 Edge, 22.0 Under (Grade III/NR)
Duct	Uninsulated
Window	U = 0.310, SHGC = 0.330

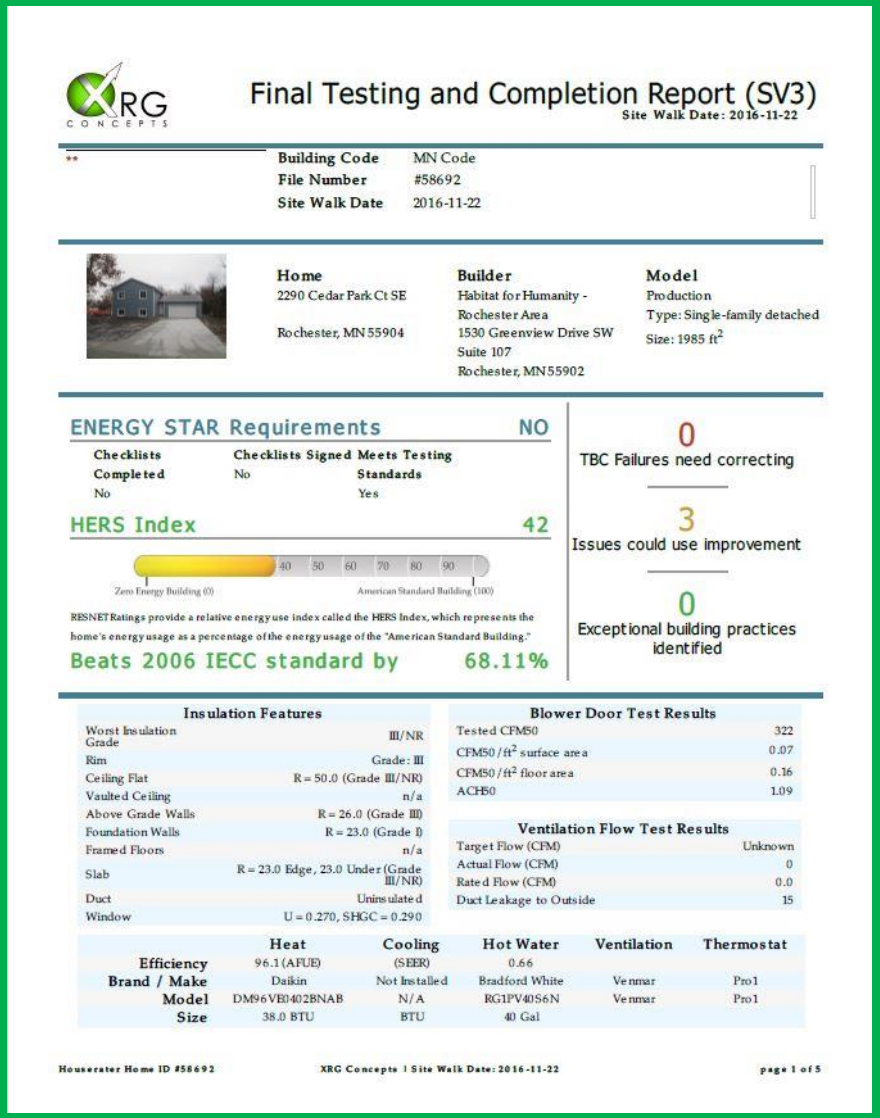
Blower Door Test Results

Tested CFM50	390
CFM50 / ft² surface area	0.09
CFM50 / ft² floor area	0.19
ACH50	1.34

Ventilation Flow Test Results

Target Flow (CFM)	Unknown
Actual Flow (CFM)	0
Rated Flow (CFM)	153.0
Duct Leakage to Outside	84

	Heat	Cooling	Hot Water	Ventilation	Thermostat
Efficiency	95.0 (AFUE)	13.0 (SEER)			
Brand / Make	Trane	Trane	Rheem	RenewAire	Honeywell
Model	TUH1B060A9361AA	4TTB3024E1000AA	43VP40E2	RenewAire	Honeywell
Size	57.0 BTU	24.0 BTU	40 Gal		
Serial Number	114930W67G		RHLNQ271229954		



XRG CONCEPTS

Final Testing and Completion Report (SV3)

Site Walk Date: 2016-11-22

Building Code	MN Code
File Number	#58692
Site Walk Date	2016-11-22

Home	Builder	Model
2290 Cedar Park Ct SE Rochester, MN 55904	Habitat for Humanity - Rochester Area 1530 Greenview Drive SW Suite 107 Rochester, MN 55902	Production Type: Single-family detached Size: 1985 ft²

ENERGY STAR Requirements NO

Checklists Completed	Checklists Signed	Meets Testing Standards
No	No	Yes

HERS Index 42

40 50 60 70 80 90

Zero Energy Building (0) — American Standard Building (100)

RESNET Ratings provide a relative energy use index called the HERS Index, which represents the home's energy usage as a percentage of the energy usage of the "American Standard Building."

Beats 2006 IECC standard by 68.11%

0 TBC Failures need correcting

3 Issues could use improvement

0 Exceptional building practices identified

Insulation Features

Worst Insulation Grade	III/NR
Rim	Grade: III
Ceiling Flat	R = 50.0 (Grade III/NR)
Vaulted Ceiling	n/a
Above Grade Walls	R = 26.0 (Grade III)
Foundation Walls	R = 23.0 (Grade I)
Framed Floors	n/a
Slab	R = 23.0 Edge, 23.0 Under (Grade III/NR)
Duct	Uninsulated
Window	U = 0.270, SHGC = 0.290

Blower Door Test Results

Tested CFM50	322
CFM50 / ft² surface area	0.07
CFM50 / ft² floor area	0.16
ACH50	1.09

Ventilation Flow Test Results

Target Flow (CFM)	Unknown
Actual Flow (CFM)	0
Rated Flow (CFM)	0.0
Duct Leakage to Outside	15

	Heat	Cooling	Hot Water	Ventilation	Thermostat
Efficiency	96.1 (AFUE)	(SEER)	0.66		
Brand / Make	Daikin	Not Installed	Bradford White	Venmar	Pro1
Model	DM96VB0402BNAB	N/A	RG1PV40S6N	Venmar	Pro1
Size	38.0 BTU	BTU	40 Gal		

Some of Our Results

XRG CONCEPTS

Site Walk Report: Insulation (SV2)

Site Walk Date: 2012-01-11

File Number #12725 Building Code MN Code
Site Walk Date 2012-01-11

MINNESOTA ENERGY RESOURCES

Home
3090 Eastwood Rd SE
Rochester, MN 55904

Builder
Habitat for Humanity - Rochester Area
1530 Greenview Drive SW
Suite 107
Rochester, MN 55902

Model
Production
Type: Single-family detached
Size: 1794 ft²

Estimated HERS Index 61

60 70 80 90

Zero Energy Building (0) American Standard Building (100)

RESNET Ratings provide a relative energy use index called the HERS Index, which represents the home's energy usage as a percentage of the energy usage of the "American Standard Building."

0
TBC Failures need correcting

1
Issues could use improvement

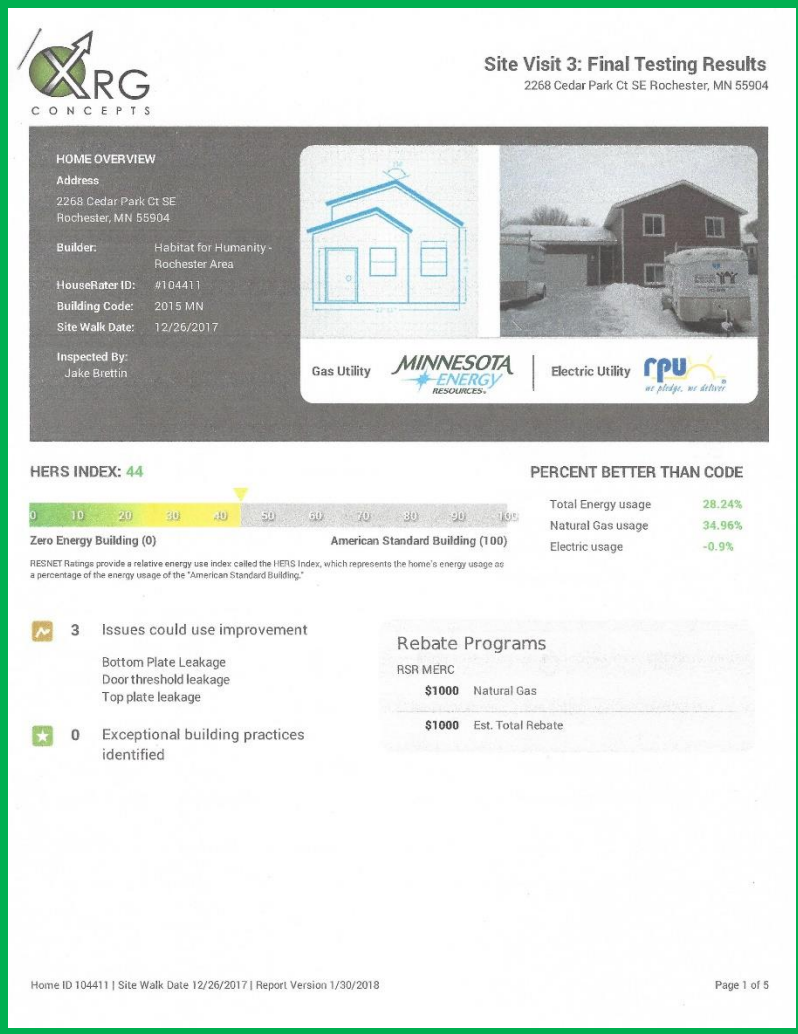
3
Exceptional building practices identified

Insulation Features

Worst Insulation Grade	III/NR
Rim	Grade: I
Ceiling Flat	R = 44.0 (Grade III/NR)
Vaulted Ceiling	n/a
Above Grade Walls	R = 24.0 (Grade I)
Foundation Walls	R = 23.0 (Grade I)
Framed Floors	n/a
Slab	R = 23.0 Edge, 23.0 Under (Grade III/NR)
Duct	Uninsulated
Window	U = 0.310, SHGC = 0.330

Heating and Cooling Plan

Heating Type	Fuel-fired air distribution
Heating Fuel	Natural gas
Heating Efficiency (AFUE)	95.00
Cooling Fuel	Electric
Cooling SEER	13.00



XRG CONCEPTS

Site Visit 3: Final Testing Results

2268 Cedar Park Ct SE Rochester, MN 55904

HOME OVERVIEW

Address
2268 Cedar Park Ct SE
Rochester, MN 55904

Builder: Habitat for Humanity - Rochester Area
HouseRater ID: #104411
Building Code: 2015 MN
Site Walk Date: 12/26/2017
Inspected By: Jake Brettin

Gas Utility MINNESOTA ENERGY RESOURCES | Electric Utility rpu we pledge, we deliver

HERS INDEX: 44

0 10 20 30 40 50 60 70 80 90 100

Zero Energy Building (0) American Standard Building (100)

RESNET Ratings provide a relative energy use index called the HERS Index, which represents the home's energy usage as a percentage of the energy usage of the "American Standard Building."

PERCENT BETTER THAN CODE

Total Energy usage	28.24%
Natural Gas usage	34.96%
Electric usage	-0.9%

3 Issues could use improvement

Bottom Plate Leakage
Door threshold leakage
Top plate leakage

0 Exceptional building practices identified

Rebate Programs

RSR MERC

$1000	Natural Gas
$1000	Est. Total Rebate

Wall Assembly

BSI-001: The Perfect Wall

Joseph Lstiburek

JULY 15, 2010

The perfect wall is an environmental separator—it has to keep the outside out and the inside in. In order to do this the wall assembly has to control rain, air, vapor and heat. In the old days we had one material to do this: rocks. We would pile a bunch or rocks up and have the rocks do it all. But over time rocks lost their appeal. They were heavy and fell down a lot. Heavy means expensive and falling down is annoying. So construction evolved. Today walls need four principal control layers—especially if we don't build out of rocks.

Microsoft Word Document

Rigid Foam Concept

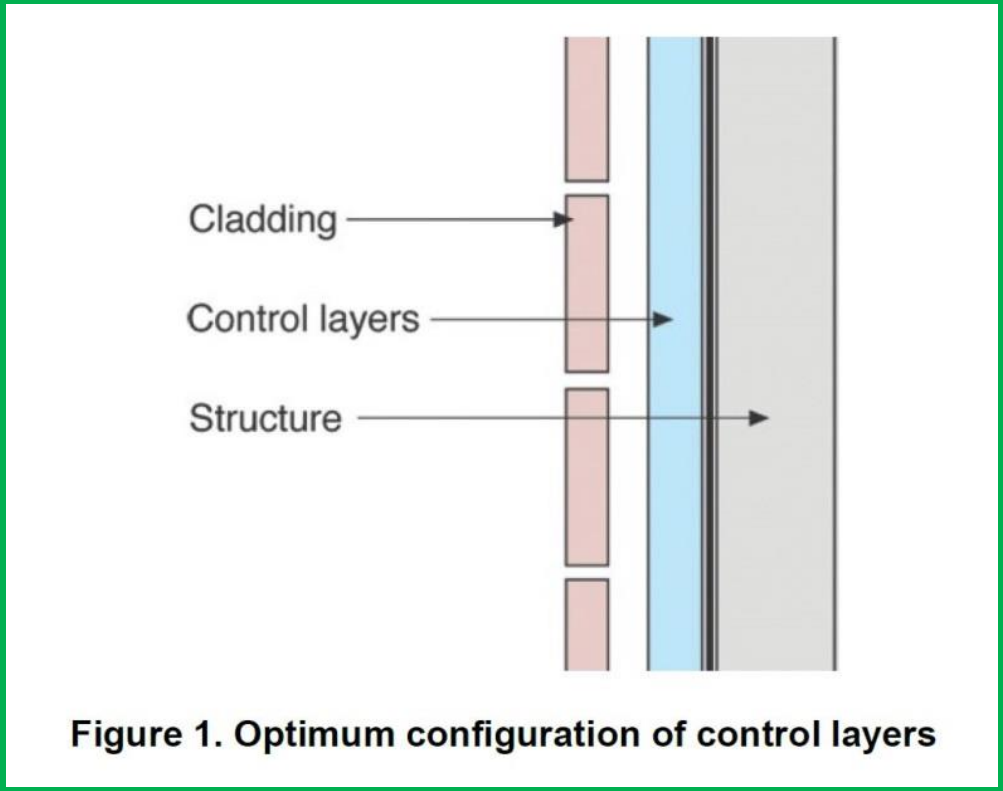


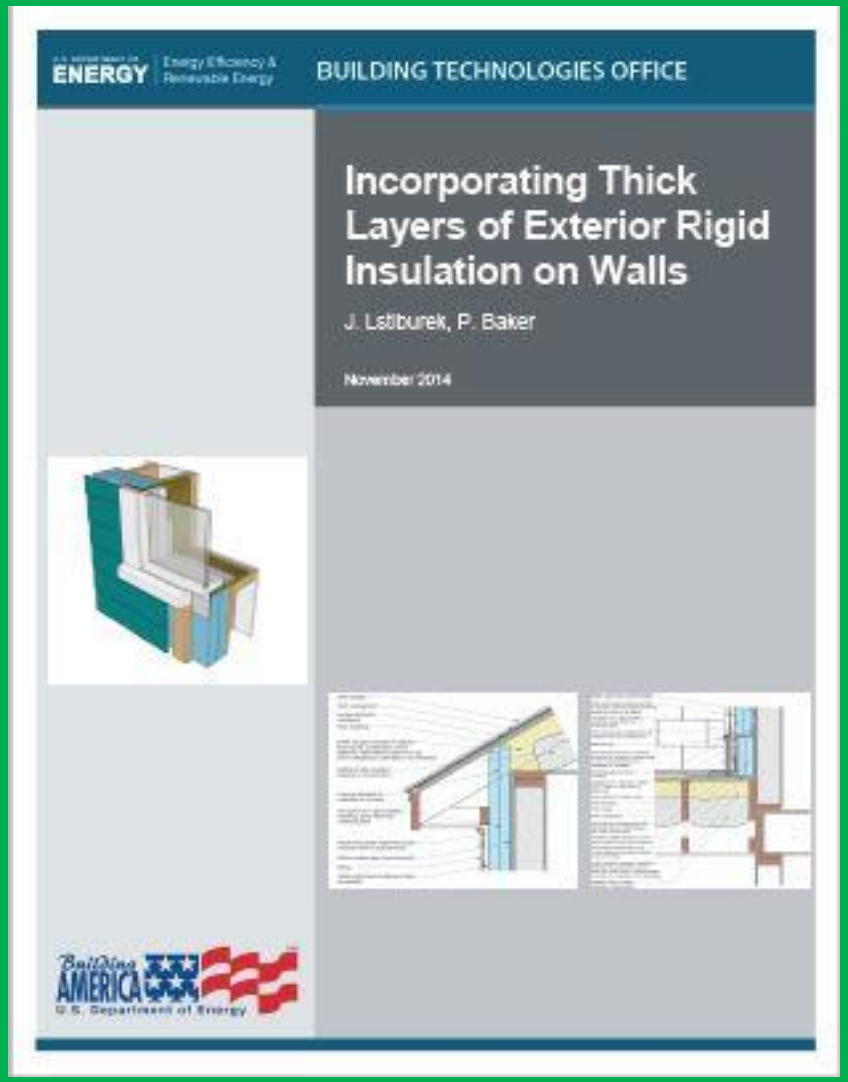
Figure 1. Optimum configuration of control layers

Thermal control layer outside the structure.

- Protecting the structure
- OSB sheathing never reaches dew point
- Dry to the inside – Class III vapor retarder

https://www.energy.gov/eere/buildings/downloads/zerh-webinar-getting-enclosures-right-zero-energy-ready-homes

Rigid Foam: choosing a method



Two methods

- Water control layer in front of rigid insulation
- Water control layer behind rigid insulation
- We chose behind rigid insulation.
- *Water control layer must be continuous and uninterrupted!*

ZERH Practices—With or Without Full Certification

Possibilities:

- One layer of foamboard
- Tighter air control
- Durability
- Water Control
- Product selection

Looking to the Future

- Product choices/imrovements
- New technologies
- Tighter control systems
- Simplified processes
- Lower cost/greater efficiency in PV/other renewables

Open Discussion

Questions?

Thoughts?

Ideas?

Concern?

Wins?

Setbacks?

Educating Customers

Sam Rashkin is Chief Architect of the Building Technologies Office in the Office of Energy Efficiency and Renewable Energy.

https://www.energy.gov/eere/buildings/doe-zero-energy-ready-home-resources