3. ARK VENTURES – GREENBRIER PROTOTYPE, OAKDALE, CT

3.1 Executive Summary

Greenbrier Prototype, Gate 3

Overview

This is a first foray into Building America level performance for the builder, Jim Pepitone and his company, Ark Ventures, LLC. Building Science Corporation (BSC) supported Ark Ventures on the design and construction of the Greenbrier model home. This home is the model home for a 14 unit subdivision in which the builder intends to demonstrate his concept of "attainable sustainable".

With the model home, the builder set out to push the envelope of what he could accomplish within a budget that the expected sale price of the home would support. To extend this budget, the builder leveraged donated product and media exposure extensively. The home has a high performance thermal enclosure with thick exterior insulation on both the roof and the walls (donated). The heating system is a dual fuel, heat pump furnace system (not donated). Whole house ventilation is provided by a central fan-integrated supply (CFIS) system. Installation of thick exterior sheathing proved very challenging for the builder. A critical seal approach as well as attention to detail during the framing stage resulted in very good air tightness.

Key Results

BSC developed details needed to reconcile flashing with the thick exterior insulation. The recurrence of particular problems resulting from application of standard practice sequencing to high-performance enclosures spurred BSC to design standard details for use with exterior insulation. On a subsequent project not involving BSC, the builder applied experience gained from working with BSC on the Greenbrier Prototype to resolve flashing errors.

The builder is very encouraged by the level of performance achieved in this prototype and is working with BSC on more economical ways to achieve high performance levels in the absence of donated materials. Ark Ventures and BSC look forward to working together on the build out of "The Houses at Greenbrier" community starting in 2010.

Gate Status

Table 6.7: Stage Gate Status Summary

"Must Meet" Gate Criteria	Status	Summary
Source Energy Savings	Pass	The prototype home exceeds the projected source energy savings target of 50% savings relative to the Building America Benchmark.
Prescriptive-Based Code Approval	Pass	The products and methods employed in the construction of the prototype home met applicable prescriptive code requirements
Quality Control Requirements	Pass	Continued successful implementation of exterior insulating sheathing and drainage plane will require inclusion of developed details in project plans and demonstration of proper techniques. Advanced framing details must be included in project plans and could also be supported by code references to aid in approvals and contractor acceptance. Air drywall approach requirements must be explained in framing and drywall sub-contractor scopes Support documents are needed to guided successful implementation of CFIS

"Should Meet" Gate Criteria	Status	Summary
Neutral Cost Target	Pass	Estimated annual energy savings relative to incremental finance costs for energy performance measures yields a positive cash flow.
Quality Control Integration	Pass	Process is in place to document lessons learned in the prototype and apply these to a community-scale development
Gaps Analysis	Pass	Additional details and construction sequence guidance is expected to resolve water management issues. Continued improvement is needed in the feasibility of cladding attachment over thick insulating sheathing. Engineering guidance is needed to move builders to realize better savings in deliberately and conscientiously designed framing.

Conclusions

Cladding attachment over thick exterior insulation remains a significant hurdle in the builder's quest to develop a system to build high performance, "attainable sustainable" homes. The Prototype home did not realize expected savings from advanced framing due primarily to 1) the approach taken to meet high wind zone requirements and, 2) the framing contractor's reluctance to implement advanced framing. BSC has facilitated a relationship between Ark Ventures and an engineer proficient in efficient wood frame structural design. For the succeeding projects in the development, Ark Ventures intends to use a different framing contractor. BSC has also identified a builder willing to share with Ark Ventures their more positive and less costly experience with exterior insulation and use of furring strips to support cladding. BSC expects that this communication will change Ark Venture's perception of the cost of exterior insulation and that careful engineering of the structure will realize savings that will allow greater investment in the thermal enclosure system.

The Builder is please with the choice of the dual fuel HVAC system. BSC hopes to conduct research into the operation of such systems in order to advise on the optimal operation parameters (e.g. switch over temperature, whether it is safe to disable defrost) of these systems.

Given the steps identified to improve the builders system and the lessons learned on the Prototype, Ark Ventures should be well positioned to meet an improving housing market with a high performance, “attainable sustainable” Building America community.

3.2 Introduction

3.2.1. Project Overview

The Greenbrier Prototype, the model home for a new subdivision, represents a first foray into Building America level performance for the builder, Jim Pepitone and his company, Ark Ventures, LLC. The builder intends the entire subdivision to be a model of his concept of "attainable sustainable" whereby he can offer high performance homes at mid-market prices. The subdivision is located in Oakdale, Southeastern Connecticut in a cold climate (5a) with strong maritime influence. It is in a 110 mph wind zone.

Building Science Corporation (BSC) supported Ark Ventures on the design and construction of the Greenbrier model home, the pilot home for the subdivision. With the model home, the builder set out to push the envelope of what he could accomplish within a budget that the expected sale price of the home would support. To extend this budget, the builder leveraged donated product and media exposure extensively. The builder positioned this home as a showcase entering it in the CT zero energy challenge 2009-2010 and pursuing NAHB National Green Building Program certification at the Emerald level.

The home contains 2,700 sf of finished space in a relatively compact design. The design achieves the generous floor area by fully occupying the space under 12:12 pitch compact roofs. A stair chase continue from the conditioned basement to the conditioned third floor. The builder designs his home to include features that he believes will attract mid-market buyers. These features include an open ground floor plan, central AC, fiber cement siding, hardwood-laminate flooring, and a semi-finished basement.

The home has a high performance thermal enclosure with thick exterior insulation on both the roof and the walls (donated). A critical seal approach as well as attention to detail during the framing stage resulted in very good air tightness. The heating system is a dual fuel, heat pump furnace system (not donated). The building is prepared to receive a 10 kW PV array designed for the house.

An undeniable success for the thermal enclosure system is the air tightness achieved: 1.5 ACH50. The Builder is please with the choice of the dual fuel HVAC system. This system was installed with only a modest cost increase over a premium efficiency split cooling-only system. Since energy modeling of this system suggests the potential for significant savings, BSC hopes to conduct research into the operation of such systems in order to advise on the optimal operation parameters (e.g. switch over temperature, whether it is safe to disable defrost) of these systems.

The Builder wrestled with challenges posed by thick exterior insulation. One of these challenges was reconciling conventional flashing practice with the sequence imposed by the addition of exterior insulation. BSC observed several water management errors during construction and either demonstrated proper detailing (with the window installation demonstration) or prepared detail drawings showing proper remediation.

The need for furring strips to attach cladding and for long fasteners to attach the furring strips and insulation panels entailed significant cost increases over the framing contract. This frustration was compounded by the fact that the builder did not realize expected savings from advanced framing. The failure to realize savings from advanced framing can be attributed to 1) the approach taken to meet high wind zone requirements and, 2) the framing contractors reluctance to implement advanced framing. The cost of fasteners was likely augmented by use of fasteners to attach insulation panels as well as to attach furring strips. BSC expects that continued communication will change Ark Venture's perceived

cost of exterior insulation and that careful engineering of the structure will realize savings that will allow greater investment in the thermal enclosure system.

Figure 3.1: Greenbrier model home

Figure 3.2: Roof overhang provides partial shading for glazing on South elevation

Figure 3.3: Premium efficiency, sealed combustion propane furnace is paired with a premium efficiency heat pump

Figure 3.4: On demand, sealed combustion hot water heater is located close to plumbing fixtures

Figure 3.5: Ark Ventures uses open floor plans to attract buyers in the target market

3.2.2. Project Information Summary Sheet

PROJECT SUMMARY	
Company	Ark Ventures, LLC
Company Profile	Ark Ventures and Ark Contractors are focused on creating conveniently located, energy efficient neighborhoods that celebrate the unique heritage of the New England communities in which they build. Ark Ventures is driven by a mission to make homes accessible for its target homebuyers' unique budgets and lifestyles. House plans strive to take into account community values, energy use and flexibility. Ark Ventures believes that Green building should be easily accessible for everyone, and that there are environmentally friendly alternatives that are also budget friendly too.
Contact Information	Jim Pepitone Ark Ventures, LLC 46 East Wharf Road Madison, Connecticut 06443 (203)-770-9066
Division Name	
Company Type	Small volume spec and custom home builder
Community Name	Greenbrier
City, State	Oakdale, CT
Climate Region	Cold (5A)

SPECIFICATIONS	
Number of Houses	1 (+13 planed in subdivision)
Municipal Address(es)	8 David Lane, Oakdale, CT 06370
House Style(s)	single family
Number of Stories	3
Number of Bedrooms	3
Plan Number(s)	n/a
Floor Area	2696
Basement Area	896
Estimated Energy Reduction	56% over BA Benchmark
Estimated Energy Savings	$3,684
Estimated Cost	[estimated construction cost – total or per sq ft]
Construction Start	March, 2009
Expected Buildout	October, 2009

3.2.3. Targets and Goals

The goal for this prototype was to exceed 50% savings relative the Building America benchmark and also to meet the performance and quality criteria. The prototype is an example of a spec-built, cold climate home achieving 50% savings relative the Building America benchmark.

3.3 Whole-House Performance and Systems Engineering

3.3.1. Energy Analysis Summary

Table 3.1: Estimated Whole House Energy Use for Greenbrier Model Homes, Oakdale, CT

ESTIMATED WHOLE HOUSE ENERGY USE		
Source (10^6 BTU/yr)	Site (10^6 BTU/yr)	Area + Bsmt (sq ft)
124	53	2696 + 896
	% Electric	No. of Bedrooms
	54%	3

With the enclosure and mechanical characteristics presented in **Error! Reference source not found.** and **Error! Reference source not found.**.5, this plan achieves a performance level of 56% reduction relative to the Building America Benchmark.

3.3.1.1. Parametric Energy Simulations

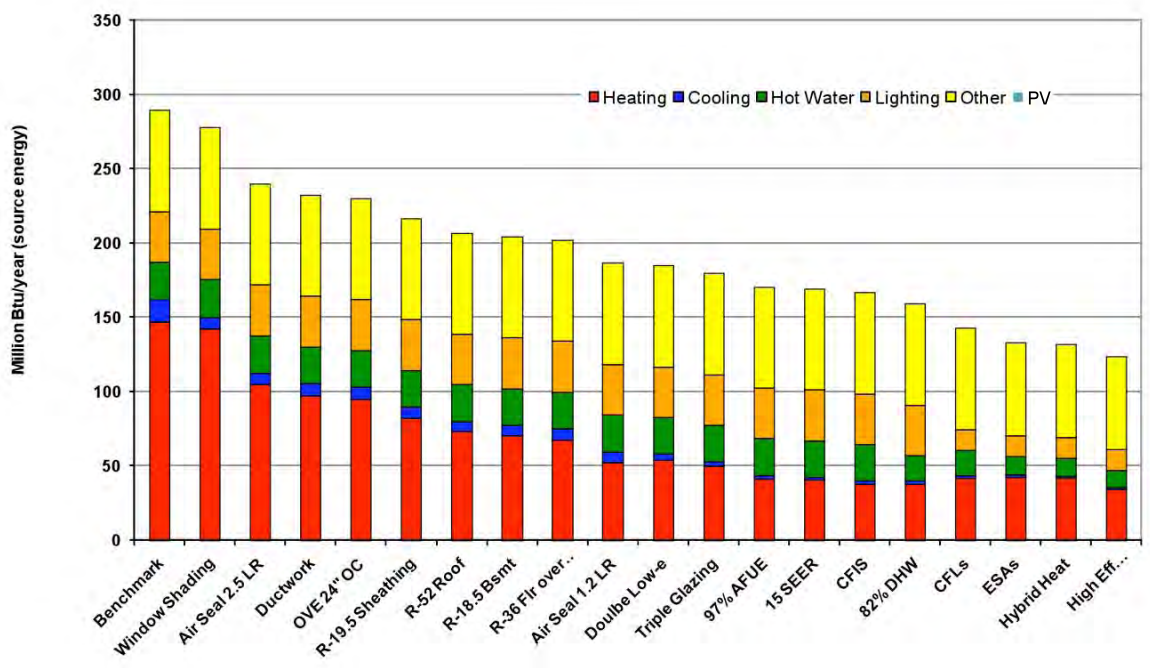


Figure 3.6: Parametric energy simulations for Greenbrier model home

3.3.1.2. End-Use Site and Source Energy Summaries

Table 3.2: Summary of End-Use Site-Energy

	Annual Site Energy			
	BA Benchmark		Prototype	
End-Use	kWh	gallons	kWh	gallons
Space Heating	883	1291	1346	148
Space Cooling	1307		64	
DHW	0	241	0	115
Lighting*	2976		1225	
Appliances + Plug	5926	0	5432	0
OA Ventilation**	72		287	
Total Usage	11164	1532	8354	263
Site Generation	0	0	0	0
Net Energy Use	11164	1532	8354	263

*Lighting end-use includes both interior and exterior lighting

**In EGUSA there are currently no hooks to disaggregate OA Ventilation, therefore it is included in Space Heating and Cooling

Table 3.3: Summary of End-Use Source-Energy and Savings

			Source Energy Savings	
	Estimated Annual Source Energy		Percent of End-Use	Percent of Total
	BA Benchmark	Prototype	Prototype savings	Prototype savings
End-Use	10^6 BTU/yr	10^6 BTU/yr		
Space Heating	146	31	**79%**	**40%**
Space Cooling	15	1	**95%**	**5%**
DHW	25	12	**52%**	**5%**
Lighting*	34	14	**59%**	**7%**
Appliances + Plug	68	62	**8%**	**2%**
OA Ventilation**	1	3	**-300%**	**-1%**
Total Usage	289	124	**57%**	**57%**
Site Generation	0	0		**0%**
Net Energy Use	289	124	**57%**	**57%**

Notes:

The "Percent of End-Use" columns show how effective the prototype building is at reducing energy use in each end-use category.

The "Percent of Total" columns show how the energy reduction in each end-use category contributes to the overall savings.

As shown in **Error! Reference source not found.**3.4, the prototype exceeds the target of 50% savings relative to the Building America Benchmark.

3.3.2. Discussion

3.3.2.1. Enclosure Design

Table 3.4 (below) summarizes the building enclosure assemblies used for this project.

Table 3.4: Enclosure Specifications

ENCLOSURE	SPECIFICATIONS
Ceiling	
Description -	Cool Vent™ roof panel with fiberglass batt insulation in rafter cavities
Insulation -	R-38 fiberglass in rafter bases, 5” Cool-Vent panel (R-21.7)
Walls	
Description -	2x6 wd framing with fiberglass cavity insulation and polyisocyanurate insulating sheathing
Insulation -	R-19 fiberglass batt with 3”(R-21) foil-faced polyisocyanurate insulating sheathing
Foundation	
Description -	Cast concrete with insulating nail-base panel interior
Insulation -	3 ½” Insulating nail base panel with OSB laminated to polyisocyanurate (R 18.5)
Windows	
Description -	Triple Pane Vinyl Spectrally Selective LoE Krypton
Manufacturer -	Harvey Industries
U-value -	0.20
SHGC -	0.19
Infiltration	
Specification -	2.5 in^2 leakage area per 100 ft^2 envelope (1803 cfm50, 4.2 ACH50)
Performance test -	1.2 in^2 leakage area per 100 ft^2 envelope (842 CFM 50, 1.5 ACH 50)]

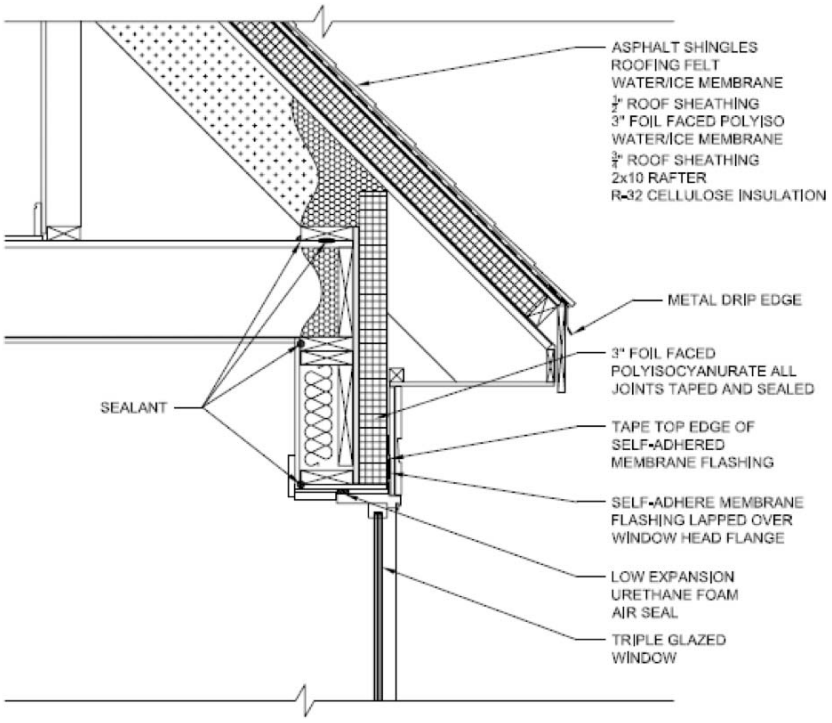


Figure 3.7: Roof and wall construction

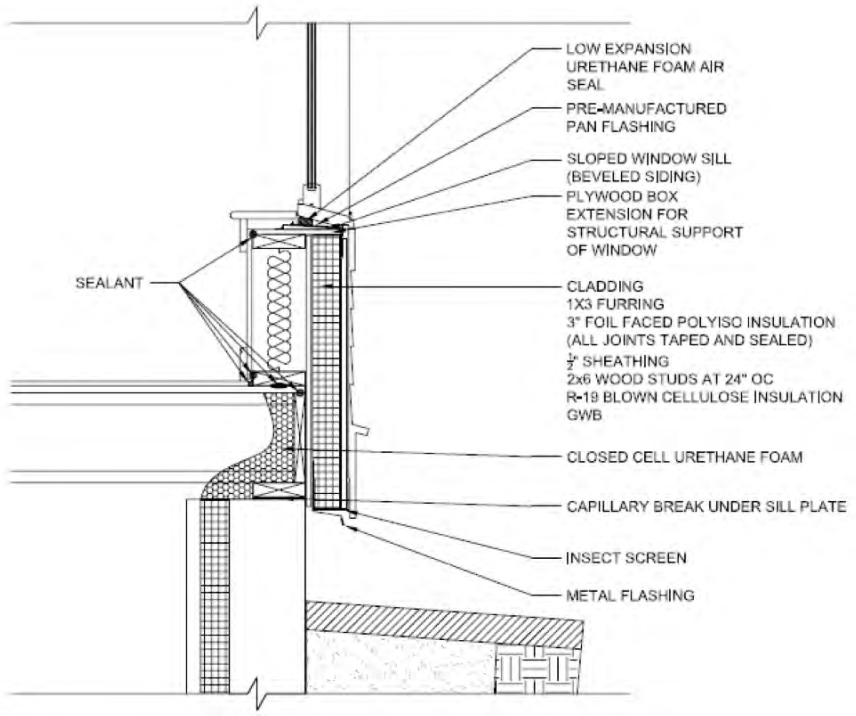


Figure 3.8: Wall and foundation construction

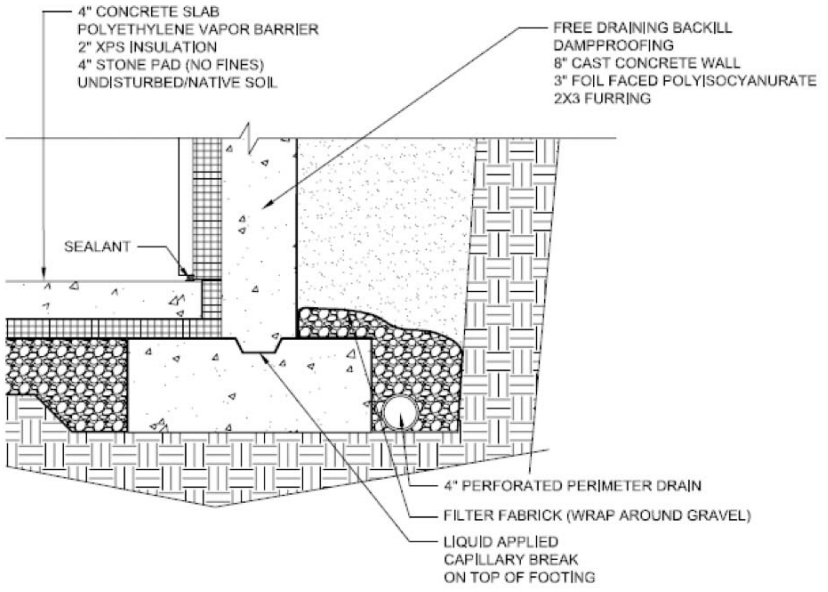


Figure 3.9: Ark Foundation and slab construction

3.3.2.2. Roof Assembly

The builder was interested in a compact roof assembly in order to be able to make full use of the space under the 12:12 pitch roof. The builder was also interested in maintaining a shingle warranty. The builder secured a donation from Hunter Panel of Cool-Vent™ roof panels. This product combines a ventilated nailbase with an insulation panel. The faced polyisocyanurate insulation layer is laminated to wood spacer blocks to which the OSB nailbase is attached. The spacer blocks allow ventilation both along the run of the slope

and across the roof slope. These panels were attached over a structural roof deck. The 5" Cool-Vent panels used provided R-21.7 insulation above the roof deck. Framing cavities were then filled with R-38 fiberglass batt insulation. The builder designed special eave and rake details to provide a screened air path into the ventilation cavity.

The Cool-Vent panel manufacturer's instructions require 24 fasteners per 4'x8' panel. The builder reported a cost for the long fasteners of ~$0.50 per fastener. This, together with the framing subcontractor's charge for installation of the panels made the system appear expensive to the builder despite the donation of material.

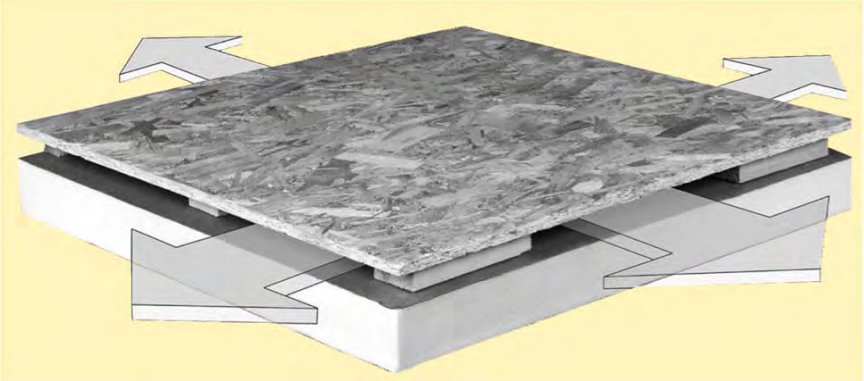


Figure 3.10: Hunter Panel Cool-Vent ventilated nailbase insulation panel

3.3.2.3. Wall Assembly

The wall assembly employs 2x6 wood framing at 24" o.c. The wall is fully sheathed with wood structural sheathing and then sheathed with a 3" foil-face polyisocyanurate insulating sheathing. The builder had applied a low-emissivity housewrap (DuPont™ Tyvek® ThermaWrap™) which had been donated over the insulating sheathing on approximately ½ the wall area of the home. When the BSC project manager pointed out that the low-emissivity housewrap offered little advantage when applied over foil-faced sheathing, he abandoned the housewrap and began taping the face of the insulating sheathing for a continuous drainage plane.

3.3.2.4. Foundation Insulation

The builder desired a cost effective solution to create a semi-finished basement. The builder accepted a donation of Hunter Panel H-Shield NB panels for use on the basement walls. These panels incorporate a polyisocyanurate insulation panel laminated to an OSB facer. Rather than directly attaching these to the concrete, the builder first installed pressure treated 2x4 strapping against the wall and then fasten the panels to these furring strips. Given the relatively impermeable OSB facer, there is some concern about elevated moisture in the furring strip cavity behind the panels.

3.3.2.5. Mechanical System Design

Table 3.5 (below) summarizes the mechanical systems used by this project.

Table 3.5: Mechanical system specifications

MECHANICAL SYSTEMS	SPECIFICATIONS
Heating	

MECHANICAL SYSTEMS	SPECIFICATIONS
Description -	97.5 AFUE Furnace with 9.5 HSPF Heat Pump
Manufacturer & Model -	York Affinity Furnace - YP9C060B12MP12C, Heat Pump – YZH02411C
Cooling (outdoor unit)	
Description -	17 SEER Heat Pump
Manufacturer & Model -	York Affinity Heat Pump – YZH02411C
Cooling (indoor unit)	
Description -	
Manufacturer & Model -	York HC42
Domestic Hot Water	
Description -	0.82 EF on-demand propane water heater
Manufacturer & Model -	Rinnai R75 LSi
Distribution	
Description -	R-4.2 flex duct runouts in conditioned space
Leakage -	none measurable to outside
Ventilation	
Description -	CFIS, 57 CFM 33% Duty Cycle: 10 minutes on; 20 minutes off
Manufacturer & Model -	Aprilaire model 8126 Ventilation Control System
Return Pathways	
Description -	Jump ducts at bedrooms and other second floor rooms, 2 returns
Dehumidification	
Description -	None installed
Manufacturer & Model -	
PV System	
Description -	None installed
Manufacturer & Model -	
Solar Hot Water	
Description -	None installed
Manufacturer & Model -	

The development is in a location without natural gas service. The builder had already decided to install a propane tank at each home in order to serve water heating and cooking. The HVAC subcontractor suggested the use of a dual fuel system involving an air-source heat pump and a gas (propane) furnace. This system allows the heat pump to serve the heating load under low load, mild temperature conditions when the heat pump is most efficient. The system would then switch to the propane furnace as temperatures approached freezing. The builder saw only a small price increase for this configuration as compared to the high efficiency furnace + split AC that he had initially intended to install. Given the typical high price of propane relative to energy content, and given the problems with capacity and efficiency of heat pumps in a cold climate, the dual fuel configuration appears to provide significant advantages as compared to a propane-only or heat-pump-only system in this climate.

3.3.2.6. Lighting and Miscellaneous Electrical Loads

The builder chose ENERGY STAR CFL lighting for 100% of the lighting in this home. The refrigerator and dishwasher are also ENERGY STAR models. Initially, the builder did not intend to provide the laundry machines but was persuaded to install a high efficiency horizontal axis clothes washing machine and dryer when he learned from his NAHB Green Building Program rater that this would garner additional points needed toward the certification goal.

3.3.2.7. Site-generated Renewable Energy

The builder has planned this home to accommodate a 7.3 or 10 kW PV system. A 10 kW system was designed for the home. The builder opted to have the eventual buyer contract with the solar installer for the PV system if the buyer chose to purchase this system. The reason for this is that the homeowner would have access to greater incentives (tax credits and rebates) than the builder.

3.4 Construction Support

3.4.1. Construction Overview

The builder very boldly leapt toward high performance objectives and showed flexibility, and attention to detail that helped the project succeed despite the challenge of new techniques. Donated materials and guidance from BSC encouraged the builder to push the performance of this model home far beyond what he had achieved in previous homes.

The builder was also very successful at garnering media attention for the innovation exhibited by this construction. This media attention was further leveraged into additional donations of materials. For example, when the builder arranged for the spray-foam insulation contractor to be on site at the same time as a TV news crew, the insulation contractor applied spray foam insulation to the entire garage walls and ceiling surfaces because the lighting in the garage proved to have better lighting for the filming of spray foam insulation demonstration.

While the builder, local realtors, and local home builders associations where very enthusiastic about the high performance measures being pursued in this project, some of sub-contractors were less so. Despite the push toward advanced framing with 24" o.c. framing, the building includes significant amount of non-structural lumber in the form of headers in non-bearing walls, multiple jack and king studs where these are not needed, solid partition blocking and >2-stud corners.

It also appeared that changes brought by exterior insulation to the overall construction process and to systems of the building (water management and insulation) were not fully grasped. In several instances application of conventional water management and flashing practices resulted in construction errors that needed remediation. BSC noticed water management errors during site visits and prepared detail drawings and instructions to guide remediation.

Figure 3.11: Step flashing installed behind the insulating sheathing drainage plane risked injecting water into the wall assembly

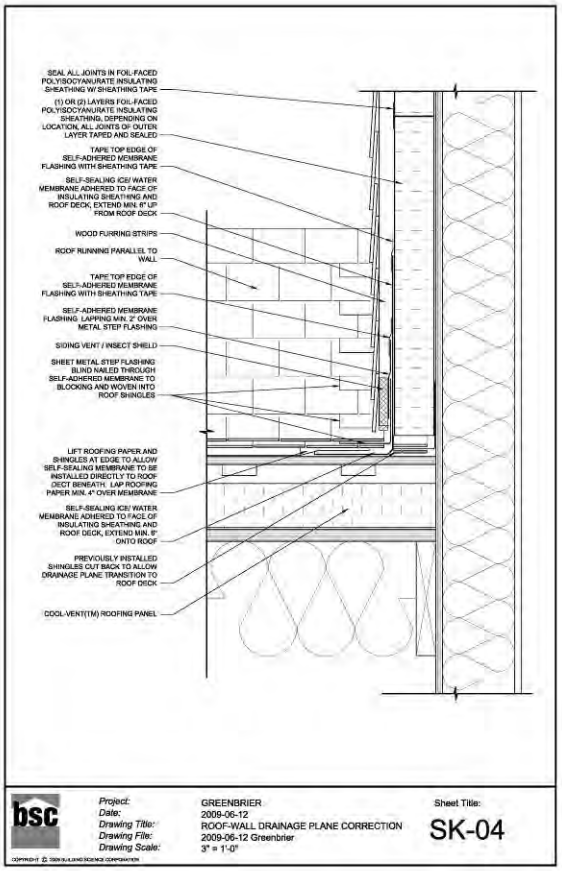


Figure 3.12: Flashing remediation detail

Integration of the drainage plane over 3' of exterior insulation proved a challenge. Attachment of insulating sheathing, furring strips and thick roof panels also proved difficulty and unanticipated expense for the builder.

In addition to providing support on implementation of the high performance enclosure, BSC worked with the mechanical subcontractor to design the heating and cooling distribution system. The relationship between BSC and the mechanical contractor was very cooperative in nature. This proved useful when the mechanical contractor arrived on site to install ductwork and found that the second floor room layout was constructed differently than on the plans. Rather than proceed with the HVAC distribution, the contractor immediately called BSC. The BSC team was able to ascertain the changes to the design and provide a revised duct layout in time to allow the mechanical system contractor to maintain his schedule.

3.4.2. Educational Events and Training

Before the framing crew installed windows in the building, the builder arranged for a window installation demonstration involving representatives from the window manufacturer (Harvey), the flashing membrane manufacturer (DuPoint) and BSC. BSC's guidance proved critical in adjusting the window installation plan so that the window could be properly flashed and integrated into the drainage plane.

Figure 3.13: Framer installing back dam material before application of sill pan flashing

Figure 3.14: Prior to BSC guided demonstration window openings had been prepared with 2x bucks over the drainage plane and proud of the sheathing plane, strapping applied around window

3.4.3. Systems Testing

BSC conducted building air tightness testing (blower door testing) just prior to drywall installation and again at project completion. BSC also conducted duct system air flow and leakage testing at project completion. At the pre-drywall testing, building air tightness was measured to be 1.65 ACH50. At project completion the airtightness measure had improved to 1.48 ACH50.

The total air distribution system leakage was much higher than expected given the obvious attention to duct sealing by the HVAC contractor. The system leakage of the two-ton nominal system was 244 cfm at 25 Pa pressurization. Inspection of the cabinet of the high performance air-handler and furnace reveal inspection ports without covers and wiring sleeves without gaskets. The system leakage test measuring leakage to the outside found zero cfm leakage to the outside.

Figure 3.15: Supply plenum showing mastic applied to the inside of the duct

Figure 3.16: Gasketed register boot

3.4.4. Monitoring

The builder has indicated that the sales contract for the home will include a provision granting the builder access to utility billing information. The builder has pledged to share this data with BSC.

3.5 Project Evaluation

The following sections evaluate the research project results based on the ability to integrate advanced systems with production building practices in prototype homes. References are made to the results from field tests and energy simulations, which are included as an appendix to this report.

3.5.1. Source Energy Savings

Requirement:	*Final production home designs must provide targeted whole house source energy efficiency savings based on BA performance analysis procedures and prior stage energy performance measurements.*
Conclusion:	***Pass***

EnergyGauge modeling performance according to BA performance analysis procedures and incorporating the systems testing data confirm that the target whole-house source energy savings exceeds the 50% savings goal. Principal energy savings strategies include:

- ***Super insulated enclosure*** – achieved by vented nailbase insulation panels on the roof deck in combination with framing cavity insulation, thick insulating sheathing on the walls in combination with framing cavity insulation, continuous insulation of foundation walls, spray foam insulation at critical transitions and at the separation between the home and the garage.
- ***High-performance windows*** – Triple glazed windows with a U-value of 0.20 and SHGC of 0.19.
- ***Building Airtightness*** – Careful sealing of framing members, application of spray foam at transitions and rim joist areas, and multiple sheathing layers contribute to impressive building air tightness.
- ***High performance dual fuel heating system*** (new approach) – Hybrid system that matches the capacity and efficiency advantages of fossil fuel heating at low temperatures with the efficiency and cost advantages of electric air-source heat pump heating at milder temperatures.
- ***High efficiency, sealed combustion on-demand water heater –*** Propane water heater at 0.86 EF. Although not represented in our analysis, the builder also located the water heater in the living space near plumbing fixtures. The plumber supplied these fixtures with a structured distribution system.
- ***100% CFL lighting***
- ***Full ENERGY STAR appliance package***

3.5.2. Prescriptive-based Code Approval

Requirement:	*Must meet prescriptive or performance safety, health and building code requirements for new homes.*
Conclusion:	***Pass***

The home meets the prescriptive safety, health and building code requirements for new homes. The interpretation of prescriptive codes as they relate to wind loads, may have prevented the realization of advanced framing benefits in this project. Future Building America work with this builder will focus on applying building codes and wood frame engineering in a way that meets structural performance requirements and allows for more efficient framing.

3.5.3. Quality Control Requirements

Requirement:	*Must define critical design details, construction practices, training, quality assurance, and quality control practices required to successfully implement new systems with production builders and contractors.*
Conclusion:	***Pass***

The prototype experience highlighted several systems that need further support for successful implementation in a productions setting. These include:

- Installation of windows with a drainage plane to the outside of thick exterior insulation,
- Water management details with a drainage plane on the outside face of thick exterior insulation,
- Cladding attachment over insulating sheathing,
- Air sealing for air-drywall approach,
- Advanced framing details,
- Central-fan integrated supply ventilation – integration with central system and location of o.a. intake,
- Ducted distribution sizing and location of registers for high performance homes, and
- Jump ducts and transfer grilles for pressure balancing.

Successful installation of windows to allow integration with a drainage plan to the outside of thick insulation is demonstrated in standard BSC details and installation sequence drawings. In addition to these drawings, BSC has found it important to demonstrate window installation for the first installed window in a building.

Standard practice often eschews proper attention to flashing details in conventional construction. Often proper flashing of such items as wall penetrations would require work that is outside of typical construction sequences. These issues are compounded when the project involves a super insulated home with exterior insulation. BSC often prepares details and sequence drawings to demonstrate proper flashing of common situations. Drawings and instruction prepared specifically for this project can be found in the appendix. BSC has also found improper execution of flashing at roof-wall intersections to be particularly common for builders unpracticed with exterior insulation and drainage plane techniques. Rather than a new detail, BSC has found that a new approach to the roof construction sequence is needed to provide the opportunity for proper flashing at the roof-wall interface. That approach is illustrated in Figures below.

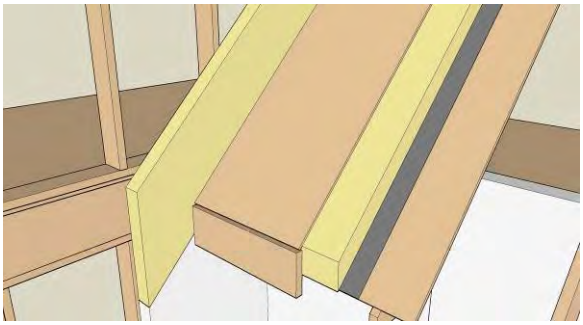


Figure 3.17: Roof construction with exterior insulation and drainage plane 1 – insulation "curb" installed prior to roofing nailbase.

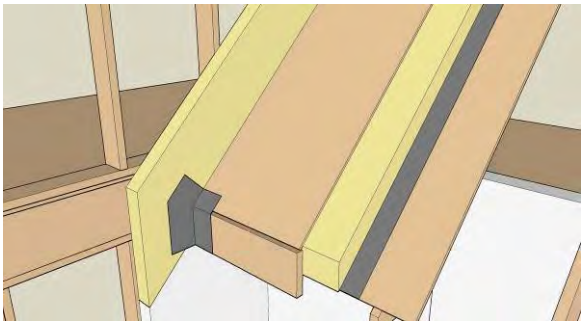


Figure 3.18: Roof construction with exterior insulation and drainage plane 2 – flashing membrane applied at junction of fascia, roof nail base and insulating sheathing

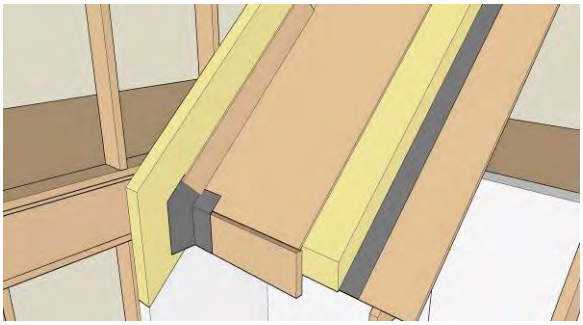


Figure 3.19: Roof construction with exterior insulation and drainage plane 3 – nailer for step flashing installed.

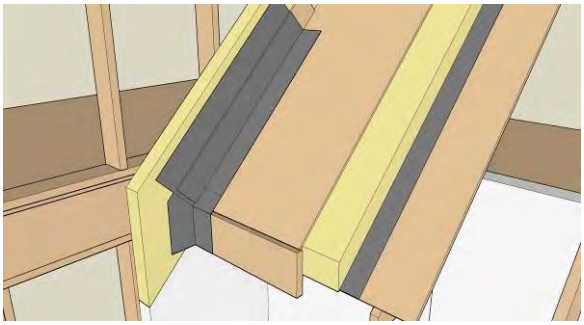


Figure 3.20: Roof construction with exterior insulation and drainage plane 4 – membrane applied over roof-wall connection

Cladding attachment over insulating sheathing is an area of continuing research for BSC. Guidance provided is generally specific to each project at this point.

BSC has developed standard details and an Information Sheet to illustrate the air-drywall approach.

BSC has developed standard details and an Information Sheet to illustrate the common advanced framing details.

Contractors unfamiliar with central-fan integrated supply ventilation will need support to implement this successfully. While installation instructions accompanying fan cycling and damper controls are relatively straight forward, guidance on best practices with regard to CFIS would still be needed. BSC has developed an Information Sheet addressing the location of ventilation intakes. Resources to explain the intent and application of CFIS as well as resources for equipment is publically available at www.fancycler.com.

BSC has developed resources to explain best practices of duct distribution sizing and location of registers for high performance homes. It is our experience that, for the first several homes that a builder builds through Building America program, it is still important to perform distribution sizing calculations and suggest duct locations for specific house

plans. It is also necessary to perform these services each time a new HVAC contractor is involved.

BSC has developed standard details and an Information Sheet to demonstrate transfer ducts and grilles for pressure balancing.

3.5.4. Neutral Cost Target

Requirement:	*The incremental annual cost of energy improvements, when financed as part of a 30 year mortgage, should be less than or equal to the annual reduction in utility bill costs relative to the BA Benchmark.*
Conclusion:	***Pass***

Builder Perspective

	Cumulative Cost[1] ($000s)	Savings ($000s)	Annual Finance Cost ($000s)	Simple cash flow ($000s)
Without PV	22.6	4.94	1.80	3.14
Add third party inspections @ $1,500	24.1		1.92	3.02
Subtract tax credit @ $2,000	22.1		1.76	3.18
With PV	61.8	5.79	4.93	0.86
Add third party inspections @ $1,500	63.3		5.05	0.74
Subtract tax credit @ $2,000	61.3		4.89	0.90

Buyer Perspective

	Sales Price Increment ($000s)	Savings ($000s)	Annual Finance Cost ($000s)	Simple cash flow ($000s)
Without PV	25.0	4.94	2.00	2.94
With PV	35.0	5.79	2.79	3.00
Subtract PV system rebates @ $3/Watt	13.1		1.05	4.74

3.5.5. Quality Control Integration

Requirement:	*Health, Safety, Durability, Comfort, and Energy related QA, QC, training, and commissioning requirements should be integrated within construction documents, contracts and BA team scopes of work.*
Conclusion:	***Pass***

BSC employed a detailed quality control checklist during the construction monitoring process. This document will serve to identify specific areas needing improvement on successive Building America projects. It will also serve as a foundation for preliminary discussions on the next projects.

3.5.6. Gaps Analysis

Requirement:	*Should include prototype house gaps analysis, lessons learned, and evaluation of major technical and market barriers to achieving the targeted performance level.*

Conclusion:	***Pass***

Coordination of water management and flashing with the insulating sheathing proved a challenge in this project. BSC has developed several details to address common flashing situations. These details must be included in drawing sets before these are reviewed for bidding by contractors. It is also apparent that the location of the drainage plane must be thoroughly explained and understood be all involved before the construction commenced.

The builder was discouraged in this project by the cost incurred for cladding attachment over thick insulating sheathing. Indeed, installation of insulating sheathing and furring strips needed for cladding attachment did require the framing crew to "go around the house" more times than they typically do. In addition to this labor cost, the cost of fasteners was also a concern for the builder. The thickness of the exterior sheathing necessitated the use of long fasteners which cost the builder between $0.35 and $60 each. The cost of fasteners was likely augmented by use of fasteners to attach insulation panels as well as to attach furring strips securing these panels. Also, the furring strips may have had more closely spaced fastening than necessary. With the use of furring strips, it is only necessary to tack the insulating sheathing in place until it can be secured by a furring strip. The challenge with this is also to be aware of drainage plane continuity and implement taping of joints before these are covered by furring strips. Cladding attachment over exterior sheathing is an area of continuing research for BSC.

Even though the application of exterior insulation could likely be further optimized, it will still represent an added cost relative to the use of framing cavity insulation only. Our analysis has found that it is very difficult to achieve 50% targets *and* provide an assembly that offers robust moisture management without the use of exterior insulation.

Framing is one of the areas where deliberate and conscientious design effort is expected to yield cost savings to support additional investment in the enclosure system. In the Greenbrier prototype, there were numerous examples of unnecessary framing lumber and of framing material that was not efficiently used. Given the practices employed, it is no surprise that the builder reported only modest lumber savings. Compounding the disappointing lumber savings, the cost of metal fastening and anchoring specified to meet structural wind loading requirements overwhelmed the savings in lumber.

The experience of the Greenbrier prototype clearly identified desiderata for effective advanced framing:

1) Contractor familiarity with- and acceptance of advanced framing practices,

2) Engineering guidance to make the best use of wood connections already inherent in the system to provide the required restraints.

BSC has identified a structural engineer whose collaboration we will encourage Ark Ventures to seek on the next project. While we believe that the investment in structural design will yield dividends of a more cost effective system, it is also true that a builder may need more than one construction iteration of a home plan to recoup this investment in design.

3.6 Conclusions/Remarks

Ark Ventures achieved an extraordinary mark in its first attempt at high performance building. The recognition that the builder has earned through this project encourages the builder to maintain this level of performance on successive homes. In light of the fact that future projects are unlikely to garner as much donated product, the builder and BSC will need to work hard to find cost and process efficiencies. Areas of research and support needs have been identified. The lessons learned in the prototype home are sure to yield efficiencies in successive homes. Given the steps identified to improve the builders system and the lessons learned on the Prototype, Ark Ventures should be well positioned to meet an improving housing market with a high performance, "attainable sustainable" Building America community.

3.7 Appendices

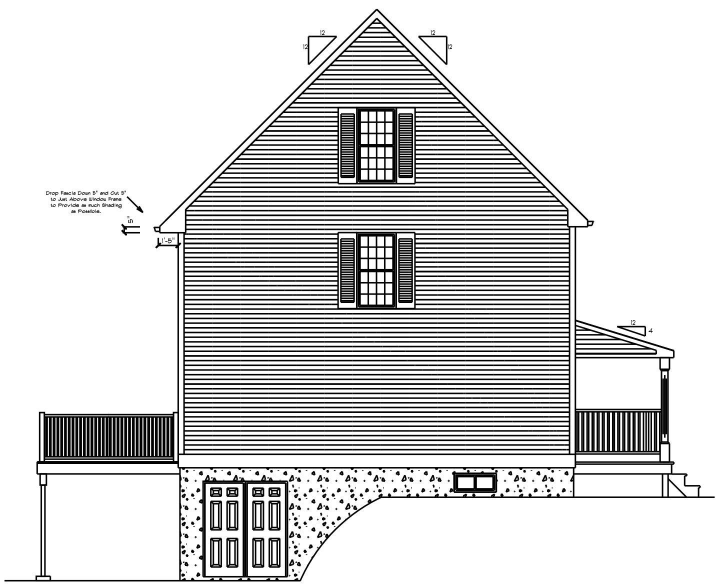
Appendix D.3.7.1
Drawings and Specifications

Square Footage

First Floor	896 sq.ft.
Second Floor	896 sq.ft.
Second Floor Flex *	328 sq.ft.
Third Floor Flex *	576 sq.ft.
Total	2,696 sq.ft.
Garage	528 sq.ft.

* Flex Areas Measured at 5' High Knee Walls

Front Elevation View



Left Side Elevation View

Ark Ventures LLC Montville, CT

This home has been designed to be built in Montville, CT which, according to Appendix M of the 2005 Amendment to the Connecticut Supplement - 2003 State Building Code, has a 110 MPH Basic Wind Speed Rating.

Revision	By
Dec 26, '08	BPH
Dec 29, '08	BPH

Nov 17, 2008
Scale = 1/4" = 1'0"
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Page 1 of 9

Front & Left Side Elevation Views

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12 David Drive 46 East Wharf Road
Montville, CT 06385 Madison, CT 06443
203-779-9066

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- Builders Association of Eastern CT
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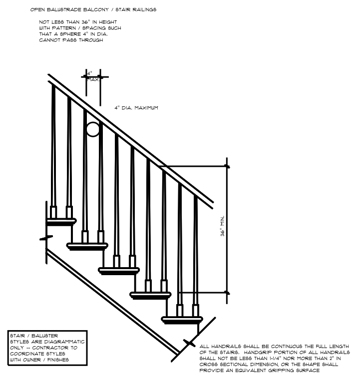
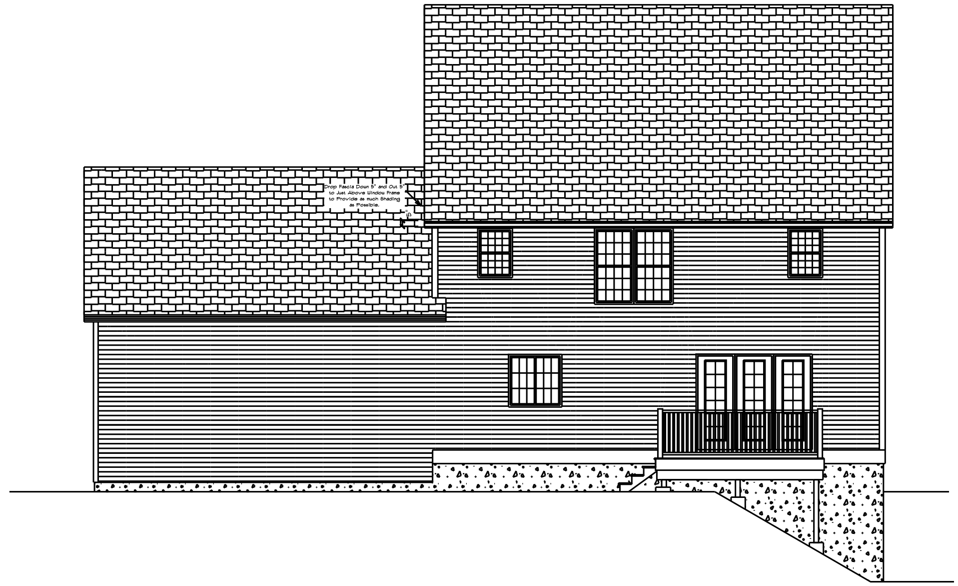
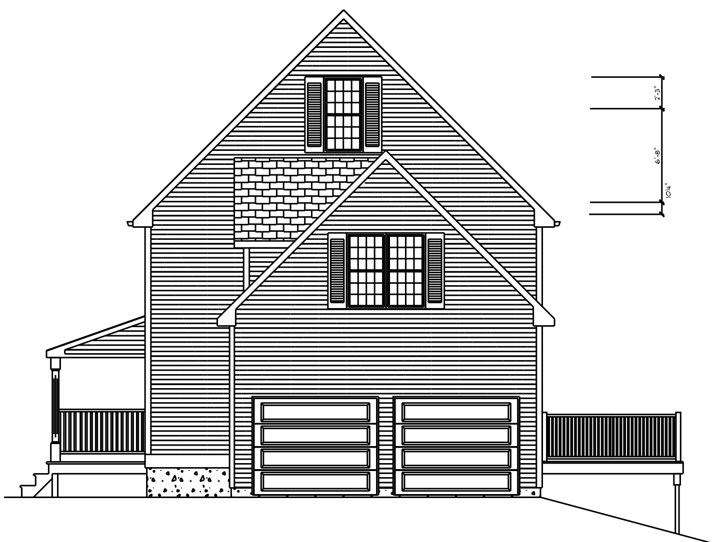
860-537-9944 fax



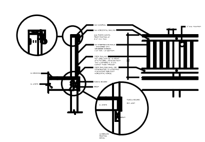
STAIR RAILING



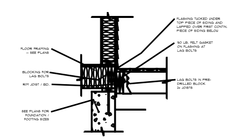
Rear Elevation View



Right Side Elevation View



DECK AND RAILING A



DECK LEDGER CONNECTION

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Rear & Right Side Elevation Views

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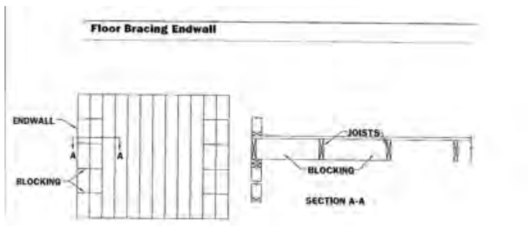
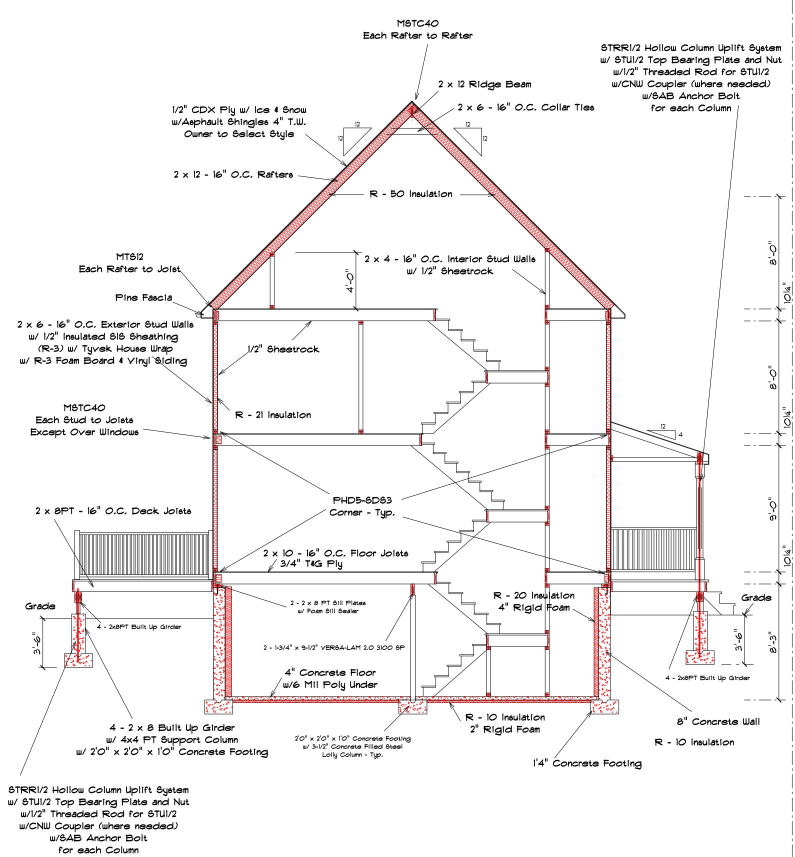
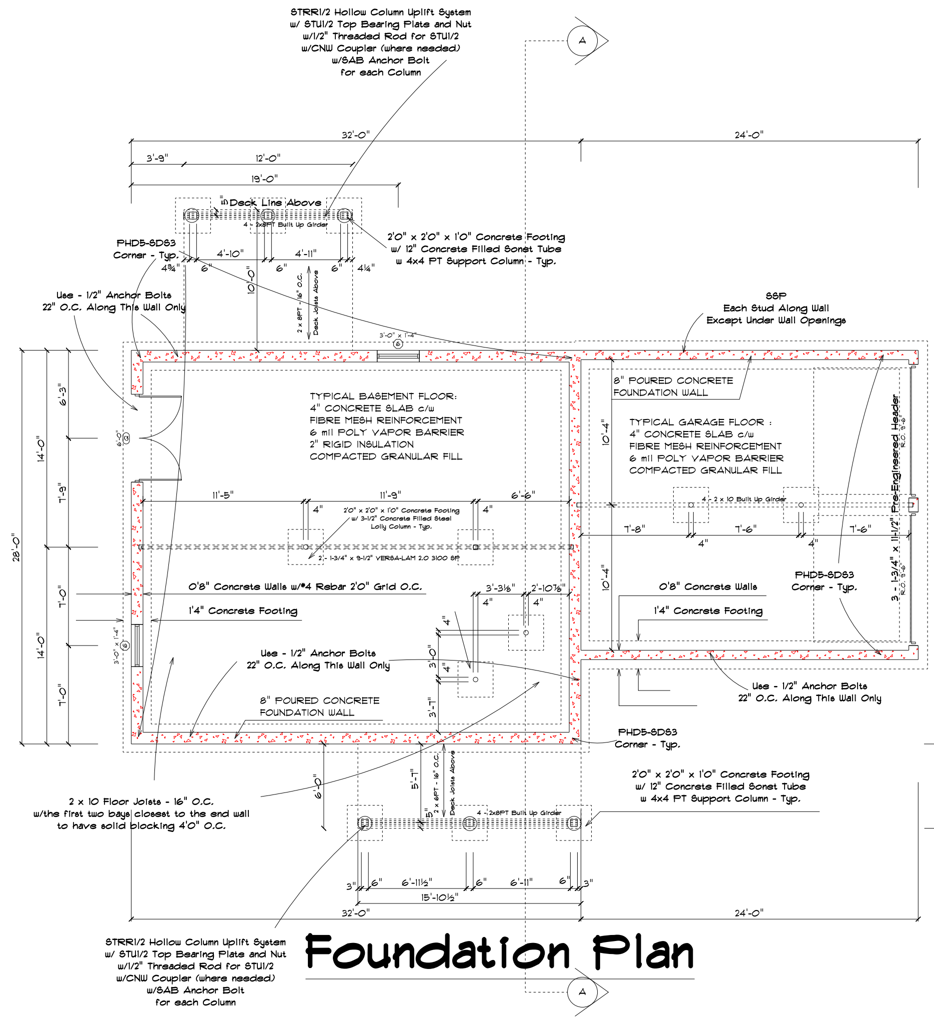



MSTC40
Each Rafter to Rafter
2 x 12 Ridge Beam
2 x 6 - 16" O.C. Collar Ties
STRRI/2 Hollow Column Uplift System
w/ STUI/2 Top Bearing Plate and Nut
w/1/2" Threaded Rod for STUI/2
w/CNW Coupler (where needed)
w/SAB Anchor Bolt
for each Column
1/2" CDX Ply w/ Ice & Snow
w/Asphault Shingles 4" T.W.
Owner to Select Style
2 x 12 - 16" O.C. Rafters
R - 50 Insulation
MTS12
Each Rafter to Joist
2 x 4 - 16" O.C. Interior Stud Walls
w/ 1/2" Sheetrock
Pine Fascia
2 x 6 - 16" O.C. Exterior Stud Walls
w/ 1/2" Insulated SIS Sheathing
(R-3) w/ Tyvek House Wrap
w/ R-3 Foam Board & Vinyl Siding
1/2" Sheetrock
R - 21 Insulation
MSTC40
Each Stud to Joists
Except Over Windows
PHD5-SDS3
Corner - Typ.
2 x 8PT - 16" O.C. Deck Joists
2 x 10 - 16" O.C. Floor Joists
3/4" T&G Ply
R - 20 Insulation
4" Rigid Foam
Grade
4 - 2x8PT Built Up Girder
2 - 2 x 8 PT Sill Plates
w/ Foam Sill Sealer
2 - 1-3/4" x 9-1/2" VERSA-LAM 2.0 3100 SP
4" Concrete Floor
w/6 Mil Poly Under
4 - 2 x 8 Built Up Girder
w/ 4x4 PT Support Column
w/ 2'0" x 2'0" x 1'0" Concrete Footing
2'0" x 2'0" x 1'0" Concrete Footing
w/ 3-1/2" Concrete Filled Steel
Lolly Column - Typ.
R - 10 Insulation
2" Rigid Foam
1'4" Concrete Footing
8" Concrete Wall
R - 10 Insulation
STRRI/2 Hollow Column Uplift System
w/ STUI/2 Top Bearing Plate and Nut
w/1/2" Threaded Rod for STUI/2
w/CNW Coupler (where needed)
w/SAB Anchor Bolt
for each Column
8'-0"
8'-0"
9'-0"
8'-3"
3'-6"
4'-0"

Cut Section A - A

Bruce P. Hajn aka "Bruno" 2008


STRRI/2 Hollow Column Uplift System
w/ STUI/2 Top Bearing Plate and Nut
w/1/2" Threaded Rod for STUI/2
w/CNW Coupler (where needed)
w/SAB Anchor Bolt
for each Column
32'-0"
24'-0"
3'-3"
12'-0"
19'-0"
Deck Line Above
PHD5-SDS3
Corner - Typ.
2'0" x 2'0" x 1'0" Concrete Footing
w/ 12" Concrete Filled Sonot Tube
w 4x4 PT Support Column - Typ.
Use - 1/2" Anchor Bolts
22" O.C. Along This Wall Only
SSP
Each Stud Along Wall
Except Under Wall Openings
8" POURED CONCRETE
FOUNDATION WALL
TYPICAL BASEMENT FLOOR:
4" CONCRETE SLAB c/w
FIBRE MESH REINFORCEMENT
6 mil POLY VAPOR BARRIER
2" RIGID INSULATION
COMPACTED GRANULAR FILL
TYPICAL GARAGE FLOOR :
4" CONCRETE SLAB c/w
FIBRE MESH REINFORCEMENT
6 mil POLY VAPOR BARRIER
COMPACTED GRANULAR FILL
3 - 1-3/4" x 11-1/2" Pre-Engineered Header
0'8" Concrete Walls w/#4 Rebar 2'0" Grid O.C.
1'4" Concrete Footing
0'8" Concrete Walls
1'4" Concrete Footing
PHD5-SDS3
Corner - Typ.
Use - 1/2" Anchor Bolts
22" O.C. Along This Wall Only
8" POURED CONCRETE
FOUNDATION WALL
Use - 1/2" Anchor Bolts
22" O.C. Along This Wall Only
PHD5-SDS3
Corner - Typ.
2'0" x 2'0" x 1'0" Concrete Footing
w/ 12" Concrete Filled Sonot Tube
w 4x4 PT Support Column - Typ.
2 x 10 Floor Joists - 16" O.C.
w/the first two bays closest to the end wall
to have solid blocking 4'0" O.C.
28'-0"
14'-0"
14'-0"
22'-0"
11'-5"
11'-9"
6'-6"
7'-6"
7'-6"
7'-6"
15'-10½"
32'-0"
24'-0"

Foundation Plan

This home has been designed to be built in Montville, CT which, according to Appendix M of the 2005 Amendment to the Connecticut Supplement - 2003 State Building Code, has a 110 MPH Basic Wind Speed Rating.

Revision	By
Dec 26, '08	BPH
Dec 29, '08	BPH

Nov 17, 2008
Scale = 1/4" = 1'0"
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Page 3 of 9

Foundation Plan
Cut Section

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46 East Wharf Road, Madison, CT 06443
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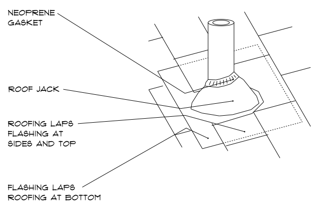
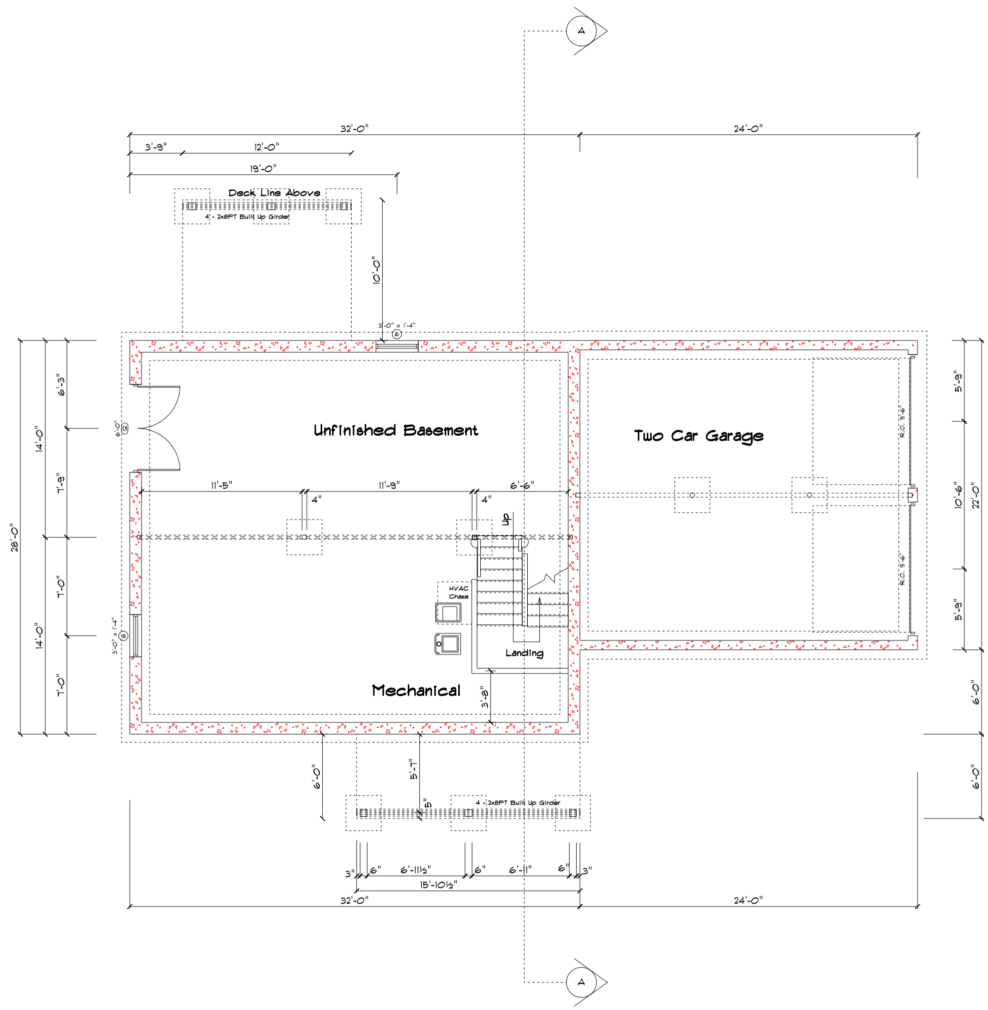


ROOF JACKS AND VENTS

Notes

Door & Window Schedule Foundation Plan Only

PRODUCT CODE	SIZE	COUNT	R.O. SIZE	TYPE	OPENING ID
36X16 SLIDER	3'-0" x 1'-4"	2	R.O. 3'-0" x 1'-4"	SLIDING WINDOW	6
72X80 COLONIAL	6'-0"	1	R.O. 6'-3"	DOOR	L



Lower Level Plan

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Lower Level Plan

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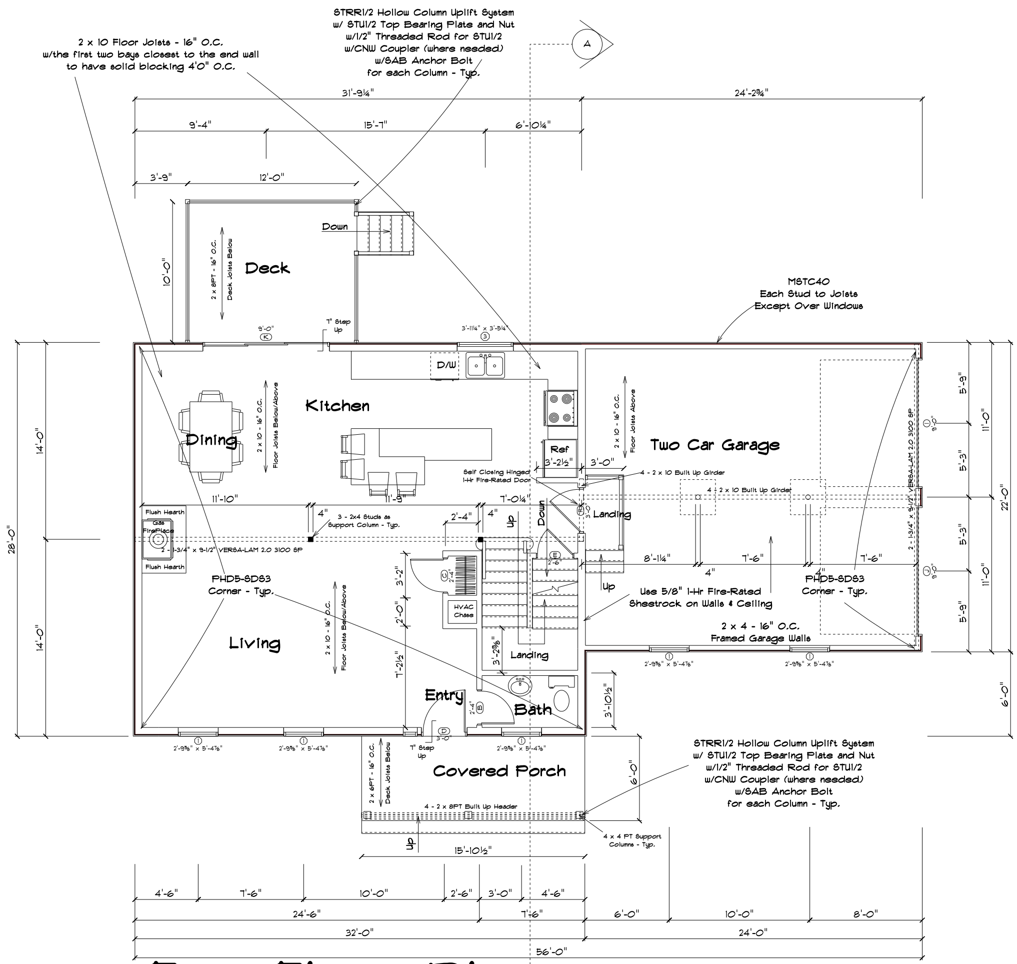
Notes

Use Douglas Fir-Larch SS for Rafters, Floor Joists, Ceiling Joists, and Stud Walls unless Otherwise Noted Here in These Plans

Door & Window Schedule
First Floor Plan Only

PRODUCT CODE	SIZE	COUNT	R.O. SIZE	TYPE	OPENING ID
TW2852	2'-9⅝" x 5'-4⅞"	5	R.O. 2'-10⅛" x 5'-4⅞"	WINDOW	1
G436	3'-11¼" x 3'-5¼"	1	R.O. 4'-0" x 3'-6"	SLIDING WINDOW	3
12X80 COUNTRY	1'-0" x 6'-9½"	1	R.O. 1'-0" x 6'-9½"	WINDOW	7
28X80 COLONIAL	2'-4"	1	R.O. 2'-6"	DOOR	B
28X80 COLONIAL	2'-4"	1	R.O. 2'-6"	DOOR	C
36X80 COLONIAL	3'-0"	1	R.O. 3'-3"	DOOR	D
30X80 COLONIAL	2'-6"	1	R.O. 2'-8"	DOOR	E
36X80 COLONIAL	3'-0"	1	R.O. 3'-3"	DOOR	F
108X84 - COUNTRY	9'-0"	1	R.O. 9'-3"	GARAGE	I
108X84 - COUNTRY	9'-0"	1	R.O. 9'-3"	GARAGE	J
108X80 SLIDING FRENCH	108X80 SLIDING FRENCH	1	R.O. 9'-0"	SLIDING DOOR	K


2 x 10 Floor Joists - 16" O.C. w/the first two bays closest to the end wall to have solid blocking 4'0" O.C.
STRRI/2 Hollow Column Uplift System w/ STUI/2 Top Bearing Plate and Nut w/1/2" Threaded Rod for STUI/2 w/CNW Coupler (where needed) w/SAB Anchor Bolt for each Column - Typ.
MSTC40 Each Stud to Joists Except Over Windows
Deck
Down
Kitchen
Dining
Two Car Garage
Living
Entry
Bath
Landing
Covered Porch
D/W
Ref
Self Closing Hinged 1-Hr Fire-Rated Door
4 - 2 x 10 Built Up Girder
PHD5-SDS3 Corner - Typ.
Use 5/8" 1-Hr Fire-Rated Sheetrock on Walls & Ceiling
2 x 4 - 16" O.C. Framed Garage Walls
HVAC Chase
Flush Hearth
4 - 2 x 8PT Built Up Header
4 x 4 PT Support Columns - Typ.
31'-9¼"
24'-2⅝"
56'-0"
32'-0"
24'-0"
28'-0"
22'-0"

First Floor Plan

Revision	By
Dec 29, '08	BPH

Nov 17, 2008
Scale = 1/4" = 1'0"
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Page 5 of 9

First Floor Plan

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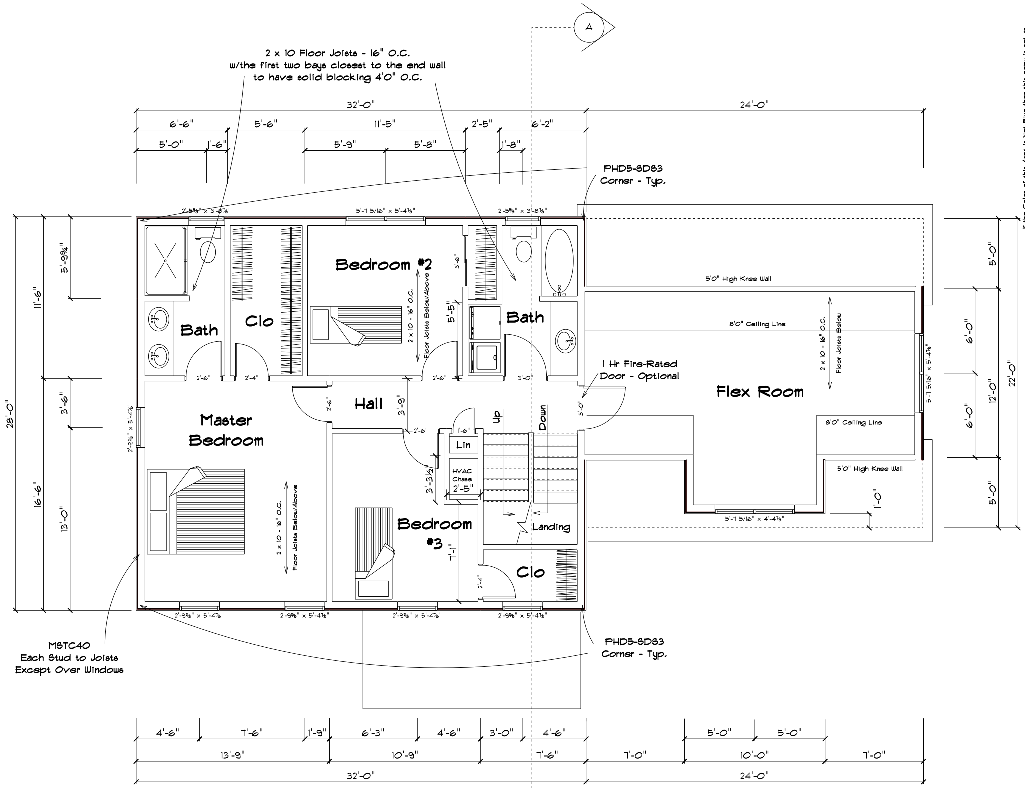
Notes

Door & Window Schedule Second Floor Plan Only

PRODUCT CODE	SIZE	COUNT	R.O. SIZE	TYPE	OPENING ID
TW2852	2'-9⅝" x 5'-4⅞"	2	R.O. 2'-10⅛" x 5'-4⅞"	WINDOW	1
TW2852-2	5'-7 5/16" x 5'-4⅞"	2	R.O. 5'-7 15/16" x 5'-4⅞"	WINDOW	6
TW2436	2'-5⅝" x 3'-8⅞"	2	R.O. 2'-6⅛" x 3'-8⅞"	WINDOW	8
TW2842-2	5'-7 5/16" x 4'-4⅞"	1	R.O. 5'-7 15/16" x 4'-4⅞"	WINDOW	9
28X80 COLONIAL	2'-4"	1	R.O. 2'-6"	DOOR	B
TW2852	2'-9⅝" x 5'-4⅞"	3	R.O. 2'-10⅛" x 5'-4⅞"	WINDOW	D
36X80 COLONIAL	3'-0"	1	R.O. 3'-2"	DOOR	I
18X80 COLONIAL	1'-6"	1	R.O. 1'-8"	DOOR	J
30X80 COLONIAL	2'-6"	1	R.O. 2'-8"	DOOR	K
30X80 COLONIAL	2'-6"	1	R.O. 2'-8"	DOOR	L
30X80 COLONIAL	2'-6"	1	R.O. 2'-8"	DOOR	M
42X80 SLIDING COLONIAL	3'-6"	1	R.O. 3'-8"	SLIDING DOOR	N
28X80 COLONIAL	2'-4"	1	R.O. 2'-6"	DOOR	O
30X80 COLONIAL	2'-6"	1	R.O. 2'-8"	DOOR	P
36X80 COLONIAL	3'-0"	1	R.O. 3'-3"	DOOR	Q



Second Floor Plan

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Builder to verify all dimensions
Follow dimensions, Do Not Scale Drawings
The Owner and Builder shall comply with all laws and statutes that govern the area by which this structure will be built
Note:
Great care and effort has come into the design and structure of these plans. However, because of the impossibility of providing any personal and or on site consultation supervision and control over the actual construction and because of variances by local building code requirements No responsibility for any damages including structural failure. Due to any deficiencies, omissions, or errors by the design of blueprints. It is reccommended that you consult a local Architect or Engineer of your choice and check with your local Building Officials prior to the start of actual construction.

Nov 17, 2008
Scale = 1/4" = 1'0"
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Page 6 of 9

Second Floor Plan

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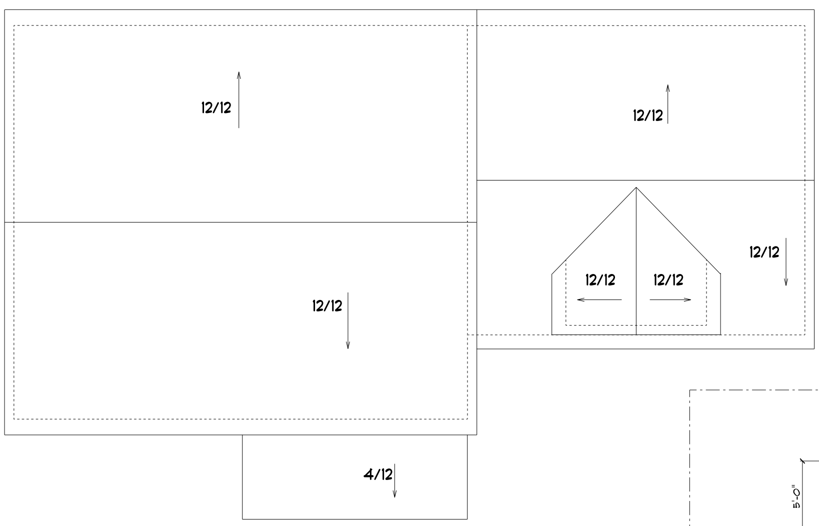
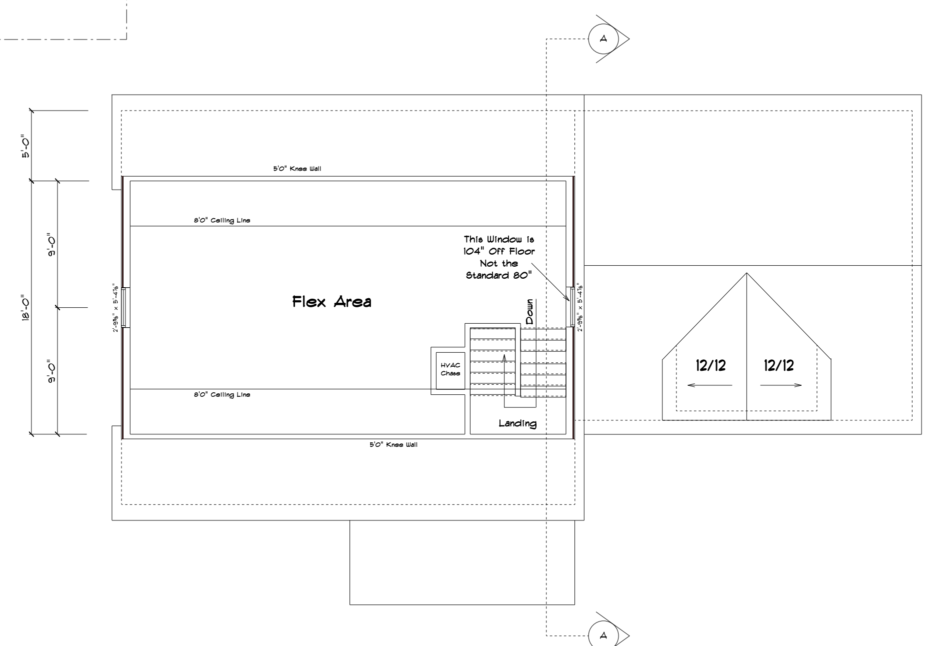


Roof Plan

Notes

Door & Window Schedule Flex Floor Plan Only

PRODUCT CODE	SIZE	COUNT	R.O. SIZE	TYPE	OPENING ID
TW2852	2'-9⅝" x 5'-4⅞"	2	R.O. 2'-10⅛" x 5'-4⅞"	WINDOW	1



Attic Floor Plan

This home has been designed to be built in Montville, CT which, according to Appendix M of the 2005 Amendment to the Connecticut Supplement - 2003 State Building Code, has a 110 MPH Basic Wind Speed Rating.

Bruce P. Hayn aka "Bruno" 2008

Revision	By
Dec 26,'08	BPH
Dec 29,'08	BPH

Nov 17, 2008

Scale = 1/4" = 1'0"

Drawn By BPH

Page 7 of 9

Attic Floor Plan Roof Plan

James Pepitone - Ark Ventures LLC
12 David Drive 46 East Wharf Road
Montville, CT 06385 Madison, CT 06443
203-779-9066

Affiliations
- Building Trades Association
- National Association of Home Builders
- Builders Association of Eastern CT
- American Institute of Building Design "AIBD"

If the Color of this Area is Not Blue then this copy is not an original and should not be accepted.

Home Designs by Bruno
31 Sashel Lane
Colchester, CT 06415
860-885-6189,
860-537-9944 fax

Ceiling Bracing Gable Endwall

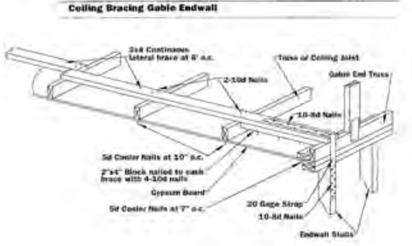


Figure 3.8a Corner Stud Holddown Detail - 3 Studs With Blocking
Figure 3.8b Corner Stud Holddown Detail - 4 Studs
Figure 3.8c Interior Stud Detail
Figure 3.8d Top Plate Intersection Detail

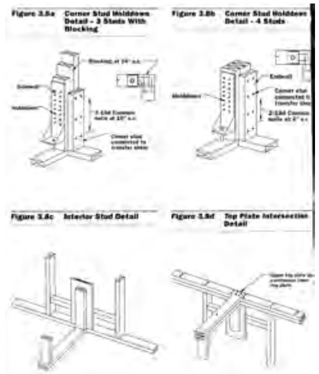
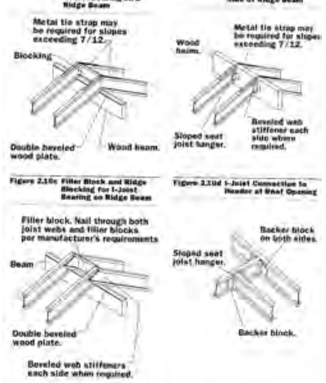


Figure 2.16a Rafter Ridge Blocking and Uplift Strap for I-Joist Bearing on a Ridge Beam
Figure 2.16b Hanger and Uplift Strap for I-Joist Attached to Side of Ridge Beam
Figure 2.16c Filler Block and Ridge Blocking for I-Joist Bearing on Ridge Beam
Figure 2.16d I-Joist Connection to Header at Roof Opening


Metal tie strap may be required for slopes exceeding 7/12.
Blocking
Double beveled wood plate.
Wood beam.
Wood beam.
Metal tie strap may be required for slopes exceeding 7/12.
Sloped seat joist hanger.
Beveled web stiffener each side where required.
Filler block. Nail through both joist webs and filler blocks per manufacturer's requirements
Beam
Double beveled wood plate.
Beveled web stiffeners each side when required.
Sloped seat joist hanger.
Backer block on both sides.
Backer block.

Bruce P. Hay aka "Bruno" 2006

Typical Detail Section for High Wind Zones

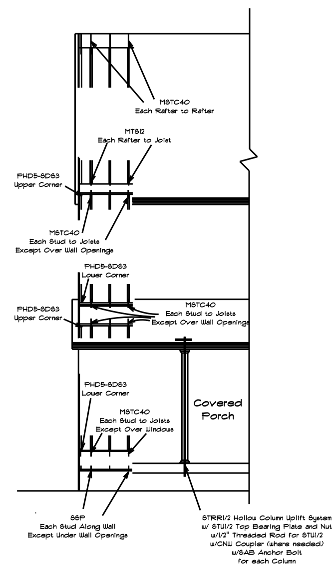
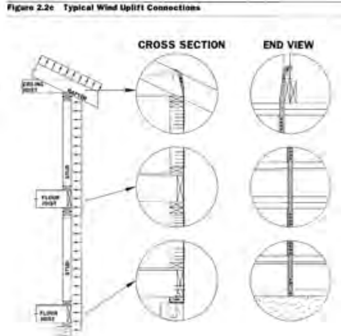

MSTC40
Each Rafter to Rafter
MTS12
Each Rafter to Joist
PHD5-SDS3
Upper Corner
MSTC40
Each Stud to Joists
Except Over Wall Openings
PHD5-SDS3
Lower Corner
PHD5-SDS3
Upper Corner
MSTC40
Each Stud to Joists
Except Over Wall Openings
PHD5-SDS3
Lower Corner
MSTC40
Each Stud to Joists
Except Over Windows
Covered Porch
SSP
Each Stud Along Wall
Except Under Wall Openings
STRRI/2 Hollow Column Uplift System
w/ STUI/2 Top Bearing Plate and Nut
w/1/2" Threaded Rod for STUI/2
w/CNW Coupler (where needed)
w/SAB Anchor Bolt
for each Column

Figure 2.2e Typical Wind Uplift Connections



Notes

- All Product Numbers shown in this design are Simpson Products. These Products Selected are intended and designed to be Used with each Products Specified Nails and Nailing Pattern.
- All Corners (outside exterior) of this Home are designed to use Simpson PHD5-SDS3 for both Top and Bottom Plates of each Floor Level. Except for Garage Door Wall.
- All Studs on Eave Walls, to use MSTC40 from Stud to Stud or from Stud to Joist. Except above and below Wall Openings.
- Details Shown are to be used for Front and Rear of Home - in each Corner and wall run - Typ.

- Header Tie Downs - Each Header will be tied using a Simpson LSTA21 strap using 16 - 10d nails when tying each side of the header to the Jack Stud.
- Full Height Studs - The Framer will use the following when constructing each header design, for headers over windows/doors (not exceeding 4 feet in width) they will install 2 full height studs, for headers over doors/windows (greater than 4 feet but not exceeding 8 feet in width) they will install 3 full height studs.

This home has been designed to be built in Montville, CT which, according to Appendix M of the 2005 Amendment to the Connecticut Supplement - 2003 State Building Code, has a 110 MPH Basic Wind Speed Rating.

Revision	By

Nov 17, 2008
Scale = 1/4" = 1'0"
Drawn By BPH
Page 8 of 9

High Wind Details

James Pepitone - Ark Ventures LLC
12 David Drive, Montville, CT 06385
46 East Wharf Road, Madison, CT 06443
203-719-3066

Affiliations
- Building Trades Association
- National Association of Home Builders
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- American Institute of Building Design "AIBD"

Home Designs by Bruno
31 Sashel Lane
Colchester, CT 06415
860-885-6189,
860-537-3944 fax

General Structural Notes

- All work shall conform to the IRC 2003 Building Code & 2004 Connecticut Amendments.
- The General Contractor shall bear sole responsibility for means and methods of construction and safety on the job site.
- The General Contractor shall furnish complete sets of architectural and structural drawings to all subcontractors for use in shop drawing preparation.
- The General Contractor shall design and provide temporary shoring as required to support construction.

Foundation / Soils

- Foundation elements have been designed for the following allowable bearing capacities. Contractor to field verify soil capacity at bottom of footing elevation.
  Allowable Soil Bearing Pressure - 4000 PSF
- Structural fill material shall consist of predominately granular soil with the following gradation:

Percent Passing	Sieve Size
100	3.5"
50 - 100	3/4"
25 - 75	#4
0 - 10	#200

- Compaction: All fill material shall be compacted to at least 95% of maximum modified optimum dry density (ASTM 1557-D) in 8" thick loose lifts.
- All footings shall be below existing fills and organic materials.
- All excavtion work shall conform to OSHA 29CFR 1926 subpart P - Excavations.
- General Contractor is to coordinate exact location and elevation of all penetrations through building walls.
- All footing shall be centered under columns unless otherwise noted.

Concrete

- Concrete mix design:
  Footing, Walls & retaining
  f'c = 3500 PSI (min.) at 28 days
  w/c Ratio = 0.50 (max)
  Min. Cement per C.Y. = 540 lbs
  Slump = 4"
  Air Entrainment = 6% for exterior exposed concrete

Wood Notes

- See architectural drawings for dimensioned layout of interior partitions and door/window opening locations.
- All framing lumber shall be Douglas Fir/Larch (north) NO. 2 grade or better, unless otherwise shown.
- Double joists shall be placed under all partition walls running parallel with joist span.
- For openings 6'-0" in width or under, install 1 jackstud + 1 full height stud. For openings over 6'-0" install 1 jackstud + 2 full height studs, unless otherwise noted.
- All openings shall be framed with double members unless otherwise noted on plans.
- Lally columns shall be constructed of 16 gauge tubular pipe consisting of low carbon steel with a minimum yield of 33,000 P.S.I. Lally columns shall be filled with concrete having a 28 day compressive strength fo 2500 P.S.I. which complies with ASTM C150 and AASHTO M-85.

Bruce P. Hayn aka "Bruno" 2006

- Engineered Lumber:
  Wood I - Joists shall be TJI Pro Series Joists (unless otherwise noted), or equivalent.
  Parallael strand lumber (PSL) shall be Parralel 2.0E by Truss Joist or equilvalent.
  Laminated veener lumber (LVL) shall be Microlam 1.9E by Truss Joists or equivalent.
  Laminated strand lumber (LSL) shall be Timberstrand 1.5E by Truss Joists or equivalent.
  Alternate products will only be permitted if approved in advance in writing by the structural engineer. Engineered lumber shall be installed per manufacturer's recommendations.
- All plywood product and installation shall conform to the requirements of the American Plywood Assoc. (APA). Leave gaps at edges as recommended.
- All metal framing connections shall be Simpson or equal.
- APA rated floor sheathing to be 3/4" T&G Plywood subfloor glued with PL400 adhesive and nailed w/8d at 12" O.C. intermediate framing members and 6" O.C. around perimeter.
- All metal hangers to be galvanized as follows:
  Pressure Treated Wood : G-185
  All other wood : G-60
  See plan for skew/slope requirements
  All hangers to be fully nailed per manufacturers nailing schedule.
- All bolts, nails and associated fasteners exposed to the weather shall be hot dipped galvanized with a minimum weight of zinc coating = 1.00 oz./ft.
- All wood framing connections shall be fastened in accordance with Table R602.3(1) of the IRC 2003.
- Plywood shear wall nailing schedule: fasten panels not less than 8d common spaced 4" O.C. along edges and 9" O.C. intermediate all vertical joints of panel sheathing shall occur over studs.
- Wall sill plates shall be anchored to foundation wall with 1/2" dia. A307 Hot-Dip galvanized anchor bolts w/washers spaced as per plan. There shall be a minimum of 2 anchor bolts per section of plate. Anchor bolts shall have a minimum 7" embedment into concrete.
- All lumber exposed to the weather shall be pressure treated. (CCG types B & D or CBA -A, CA-B) level of treatment shall be in accordance w/AWPA standards for retention based on end use application (above ground use, ground contact, decking, etc.)

Wind Design Information

- This house is located in a wind borne debris region as defined in the IRC 2005 Building Code.
- The owner/contractor shall provide wood structural panels with a minimum thickness of 7/16" pre-cut to cover all glass on the first and second stories of the home, or convert all glass to tempered high wind impact glass - DP50 Andersen as example. The panels shall be stored on site in a readily accessible area with all hardware necessary for proper installation - see fastening chart below. In advance of a high wind event, the owner shall install the pre-cut panels over the glass openings on each floor & all openings wider than 8 feet shall have impact resistance glazing.

- WIND BORNE DEBRIS PROTECTION FASTENING SCHEDULE FOR WOOD STRUCTURAL PANELS

Fastener Type	Fastening Spacing		
	Panel Span < 4 Foot	4 Foot < Panel Span < 6 Foot	6 Foot < Panel Span < 8 Foot
2-1/2" #6 Wood Screws	16"	12"	9"
2-1/2" #8 Wood Screws	16"	16"	12"

- Fasteners shall be installed at opposing ends of the wood structural panel.

General Notes

1. Owner shall, at its own expense, construct and build this construction project in accordance with the following provisions, supplying all material and performing all labor. Such construction shall comply with all respects with applicable codes and shall be completed in a first class workmanlike manner. All construction shall comply with all building and fire regulations to include all fire-resistant regulations and materials as so noted in this design. Any modifications of this design, requiring the movement of any structural members or redesigns of, must first be consulted with this designer or like designer, and be brought up to the local building officials for their approval and acceptance.
2. PERMITS. The owner/builder is responsible for any and all building permits and shall pay for such permits, licenses, and inspections necessary to complete this project.
3. DEMOLITION (If Needed). Any demolition required to prepare this project for construction will be completed as part of this project by the owner or its representative. Adequate bracing and dunage required to sustain structural integrity during construction have not been designed into this design and is therefore the responsibility of the owner to ensure safe and secure construction during this time.
4. HEATING, VENTILATION, AND AIR CONDITIONING SYSTEMS. Owner shall furnish and install all related equipment adequate to serve the entire home as required by applicable building codes and requirements.
5. Contractor shall maintain continuous control of surface and subsurface water to ensure that the work is done under dry conditions on compacted fill.
6. Builder to verify all dimensions
7. Follow dimensions, Do Not Scale Drawings
8. The Owner and Builder shall comply with all laws and statutes that govern the area by which this structure will be built
9. NEW STRUCTURE. All new construction shall include all connections, reinforcements, and bracing required and not explicitly stated on drawings.
   a. EXTERIOR WALLS. New exterior walls shall be 2 x 4 - 16" O.C. stud wall framing with 1/2" CDX Plywood. This plywood will then be wrapped using Tyvek House Wrap material, or the like, with siding applied over. Actual siding to be used is so noted in Cut Sections provided in this drawing. Insulation will be open faced standard batt insulation placed inside each open framing. 4 mil plastic will then be applied over the inside of the exterior wall studs and secured. Actual "R" value to be used is so noted in Cut Sections provided in this design.
   b. INTERIOR WALLS. Interior walls shall be 2 x 4 - 16" O.C. stud wall framing.
   c. SHEETROCK. 1/2" sheetrock will be used in all areas of this project accept where noted. 5/8" 1 Hour Fire Rated Sheet Rock must be used in all garage spaces that connect to any and all living spaces of the home. Proper tapping and compounding must be adhered to to complete proper seal and desired appearance.
   d. INSULATION. All insulation will comply with all Federal and State requirements. A RECHecks report is included with this design and provided under separate document. All required "R" values are so noted in this document and will take prescent over any other note indicating insulation and/or R values. All black plumbing pipe must be wrapped with insulation. All bathroom fiberglas fixtures must be wrapped or stuffed with insulation.
   e. CONCRETE. All concrete must use a minimum of 3,000 lb mix with 3/4" stone. Any and all indication of higher requirements will be noted in this design and will take presient over. Back fill shall be placed and compacted simultaneously on both sides of the foundation walls. Concrete wall must be sealed with asphalt based sealer, either rolled on but preferribly sprayed on to ensure seal. Use 6 mil poly under concrete floors.
   f. HEADERS. All doorway and window headers, with widths not exceeding 3'0", will be 2 x 8 built up beams with 1/2" plywood sandwiched in between them. All wider openings will be as follows: 3'1" to 6'0" must use 2 x 10 header with 3/4" plywood sandwiched in between, 6'1" to 8'0" must use 2 x 12 header with 3/4" plywood sandwiched in between. All opening 8'1" and wider will be so noted in the design as to its requirement.
   g. SOIL CONDITIONS ASSUMED. Soil conditions are based on the test pits for the septic system from the site plan reviewed described as 3" of Top soil, 2" to 20" of sandy sub soil, 20" to 100" of gravel with some stone 4" to 12" in diameter. The soil is considered to be 4,000 pound per square foot.
10. Great care and effort has come into the design and structure of these plans. However, because of the impossibility of providing any personal and or on site consultation supervision and control over the actual construction and because of variances by local building code requirements No responsibility for any damages including structural failure. Due to any deficiencies, omissions, or errors by the design of blueprints. It is reccommended that you consult a local Architect or Engineer of your choice and check with your local Building Official prior to the start of actual construction.

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Nov 17, 2008
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Page 9 of 9

General Notes

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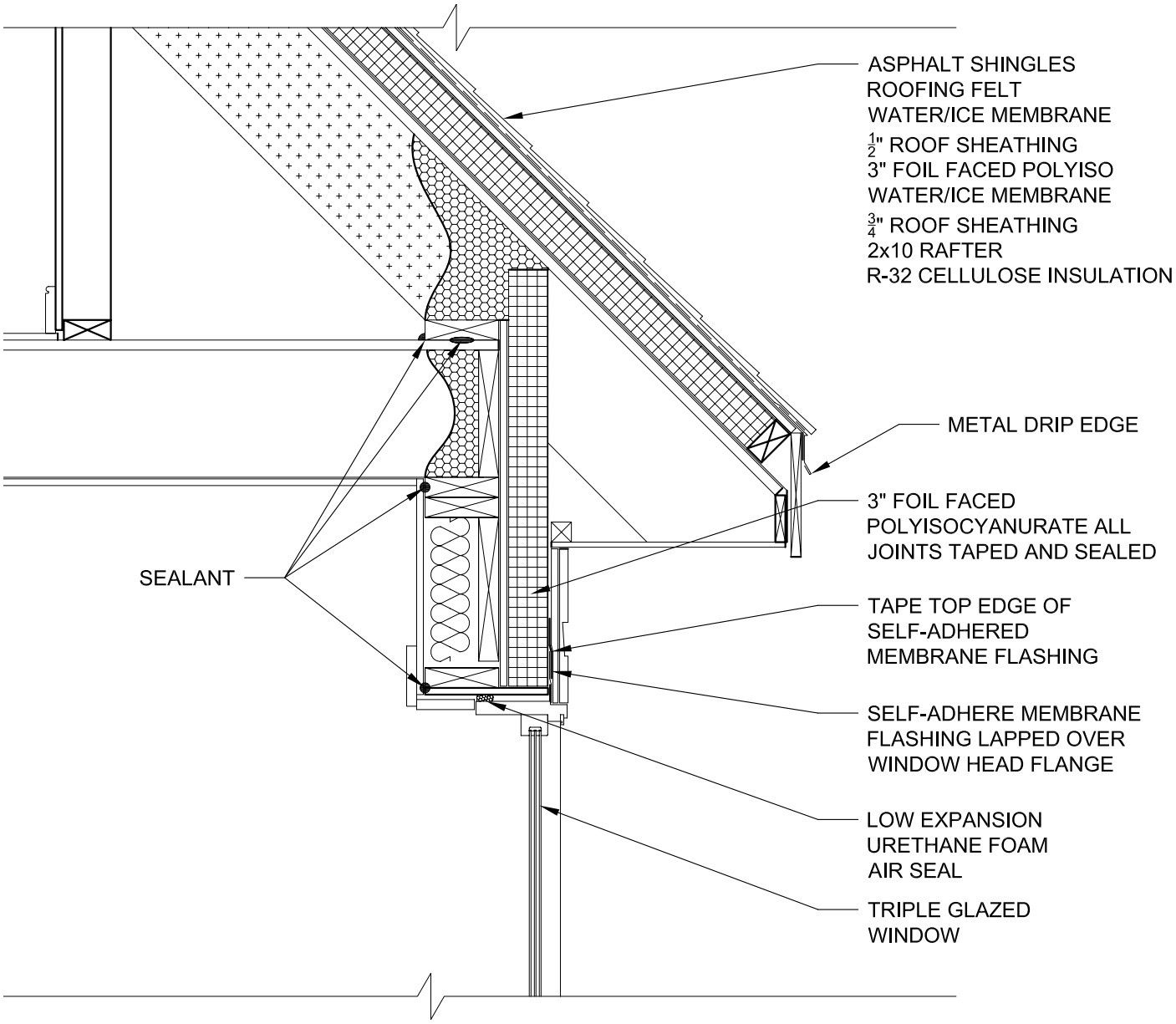
Appendix D.3.7.2
Details Prepared by BA Team



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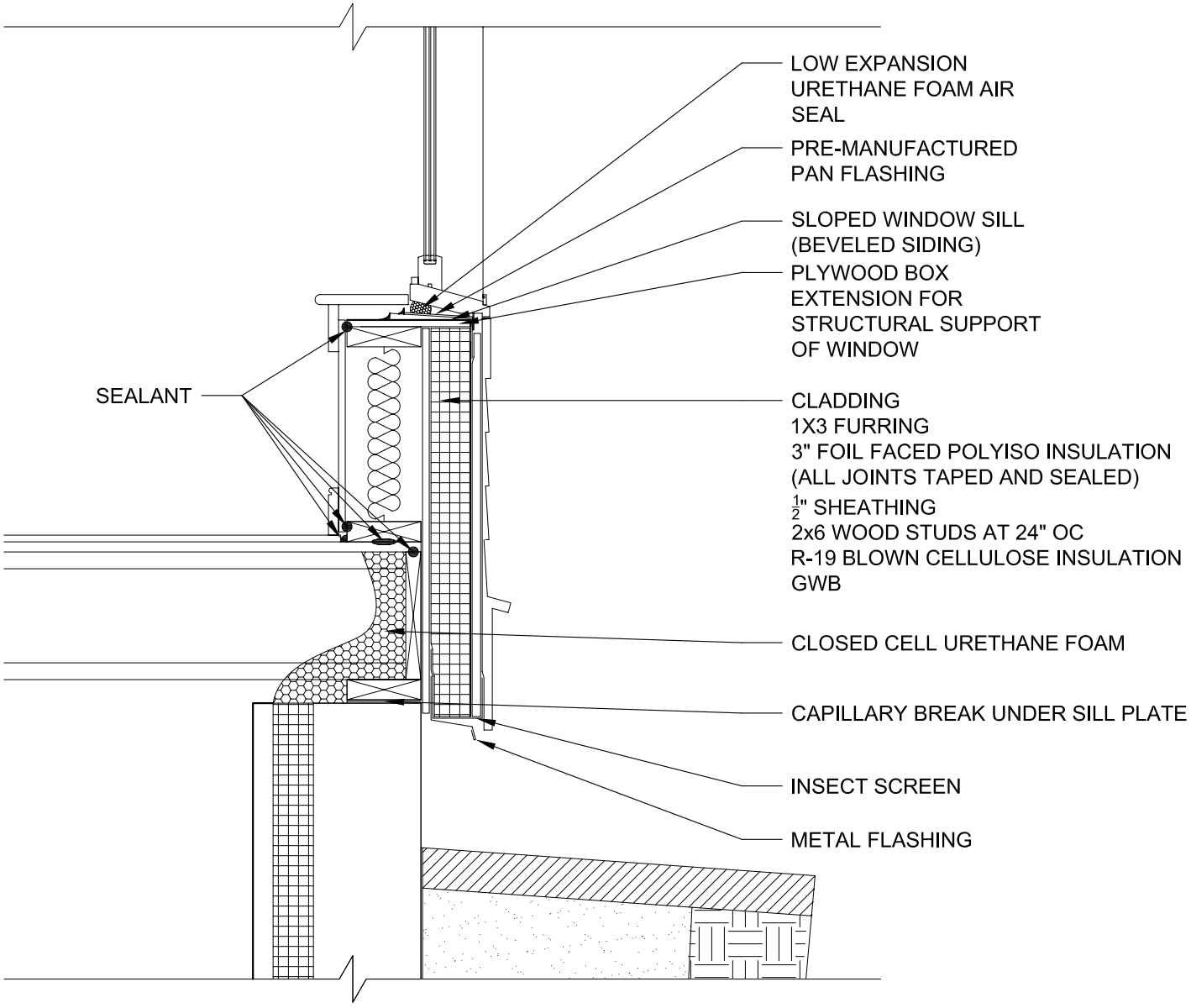
Drawing Title:	ROOF SECTION
Drawing File:	2009-02-18 Greenbrier
Drawing Scale:	1" = 1'

Sheet Title:

SK-01



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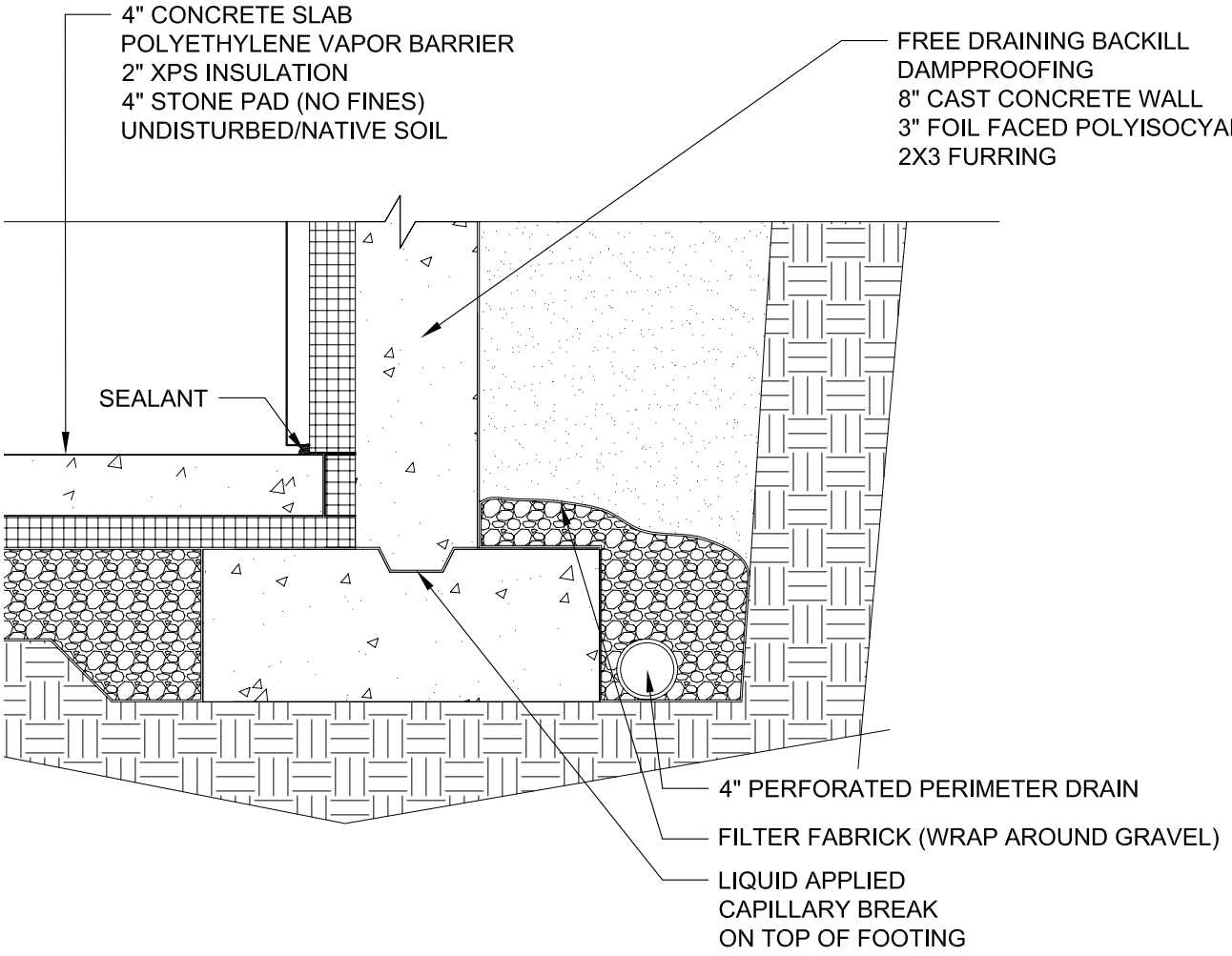
Drawing Title:	WALL SECTION
Drawing File:	2009-02-18 Greenbrier
Drawing Scale:	1" = 1'

Sheet Title:

SK-02



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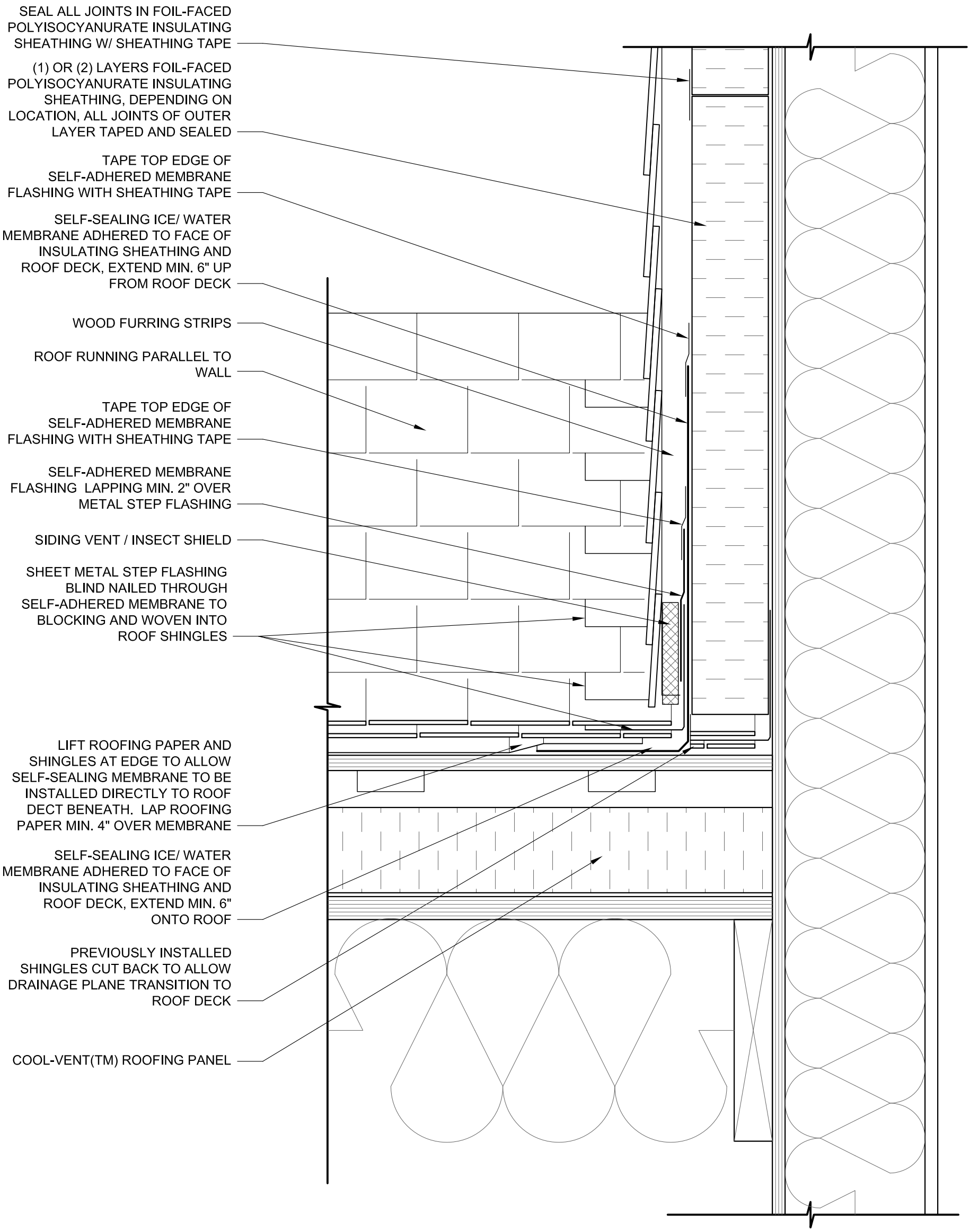
Drawing Title:	FOUNDATION SECTION
Drawing File:	2009-02-18 Greenbrier
Drawing Scale:	1" = 1'

Sheet Title:

SK-03



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Date:	2009-06-12
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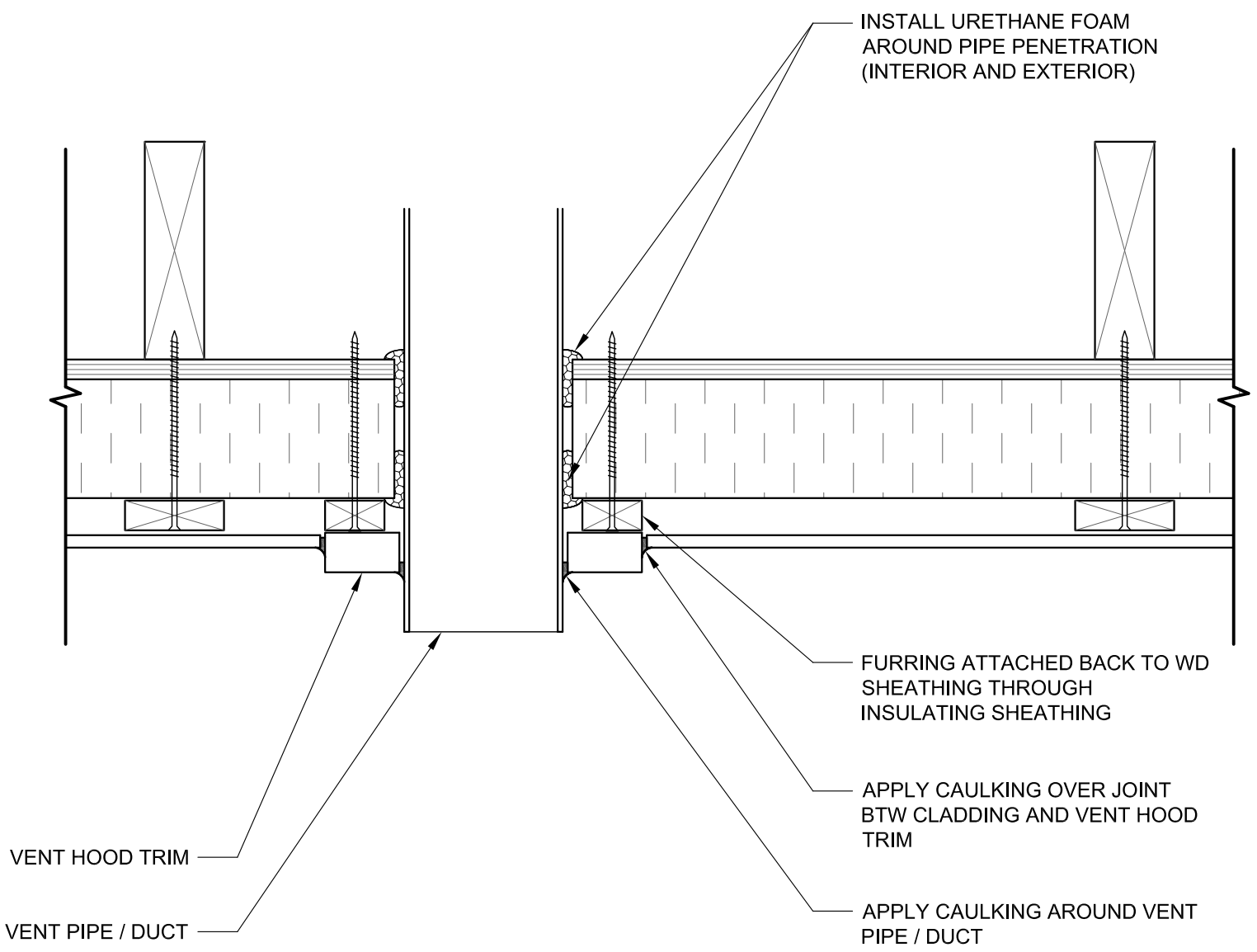
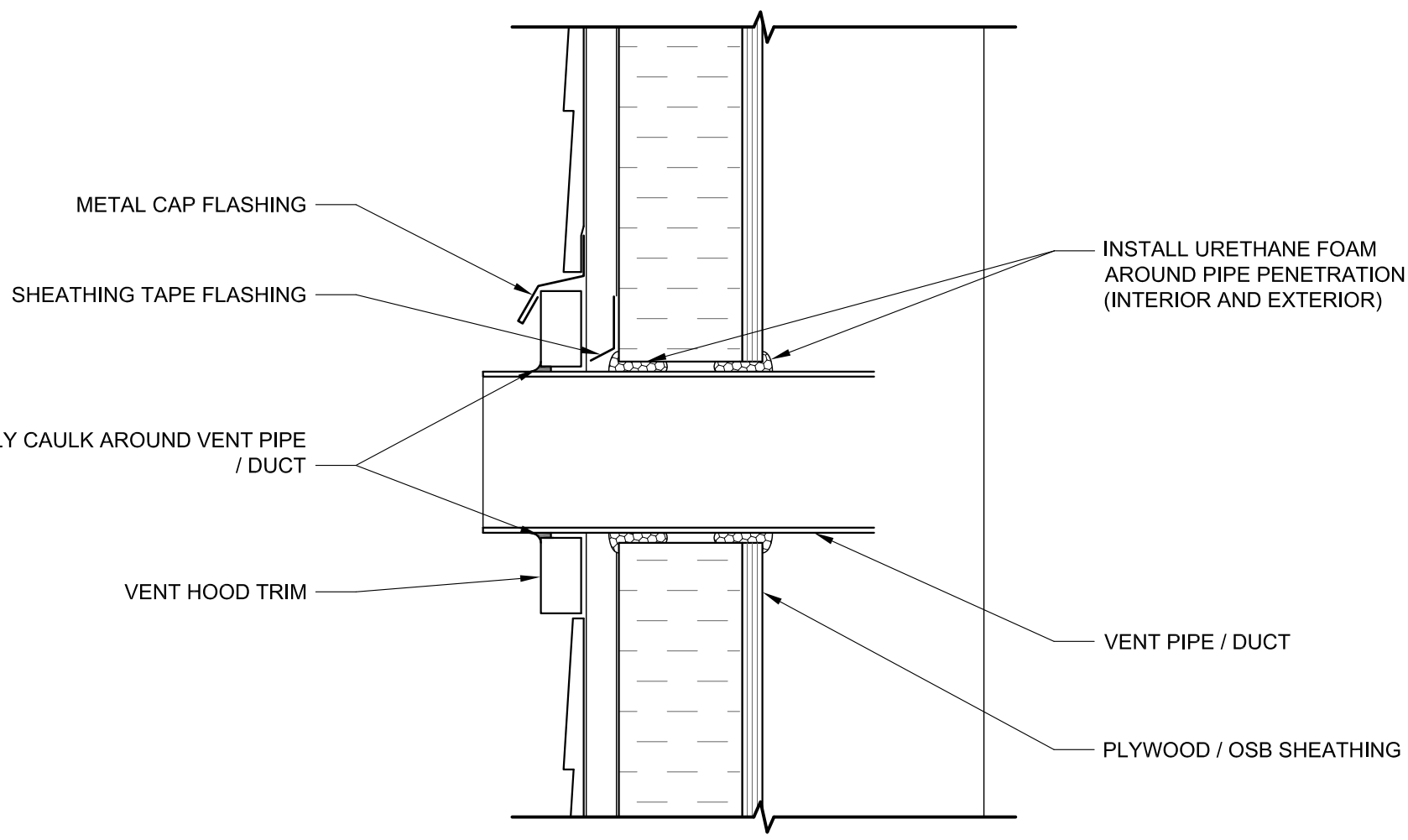
Drawing File:	2009-06-12 Greenbrier
Drawing Scale:	3" = 1'-0"

Sheet Title:

SK-04





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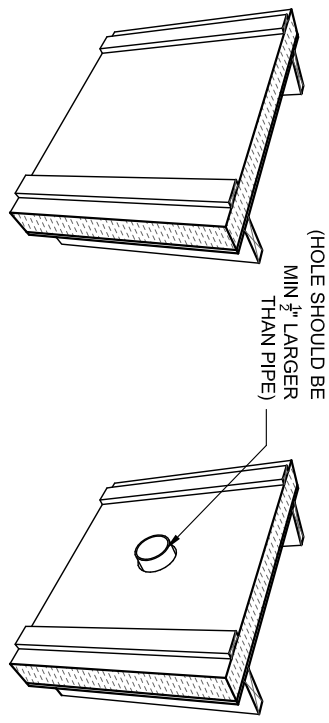
Date:	2009-06-12
Drawing Title:	ENCLOSURE PENETRATION DETAIL - DUCT
Drawing File:	2009-06-12 Greenbrier
Drawing Scale:	3" = 1'-0"

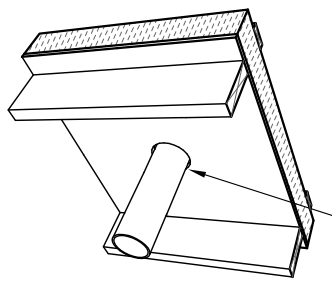
Sheet Title:

SK-05

PIPE / DUCT INSTALLATION SEQUENCE



STEP 1



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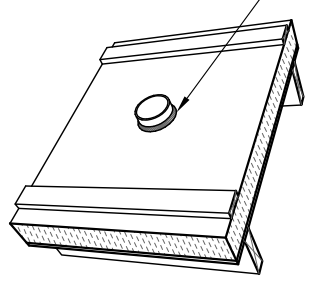

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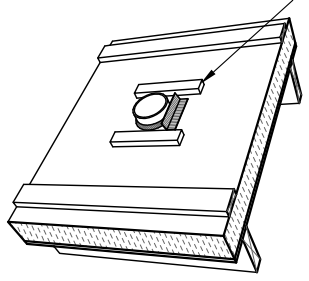
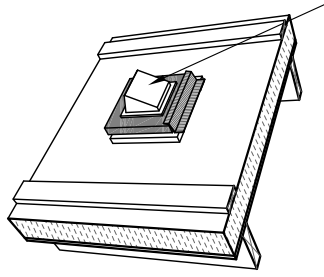
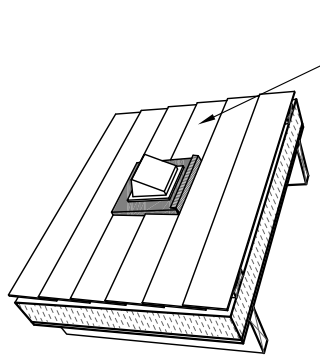


STEP 4

STEP 5



STEP 6

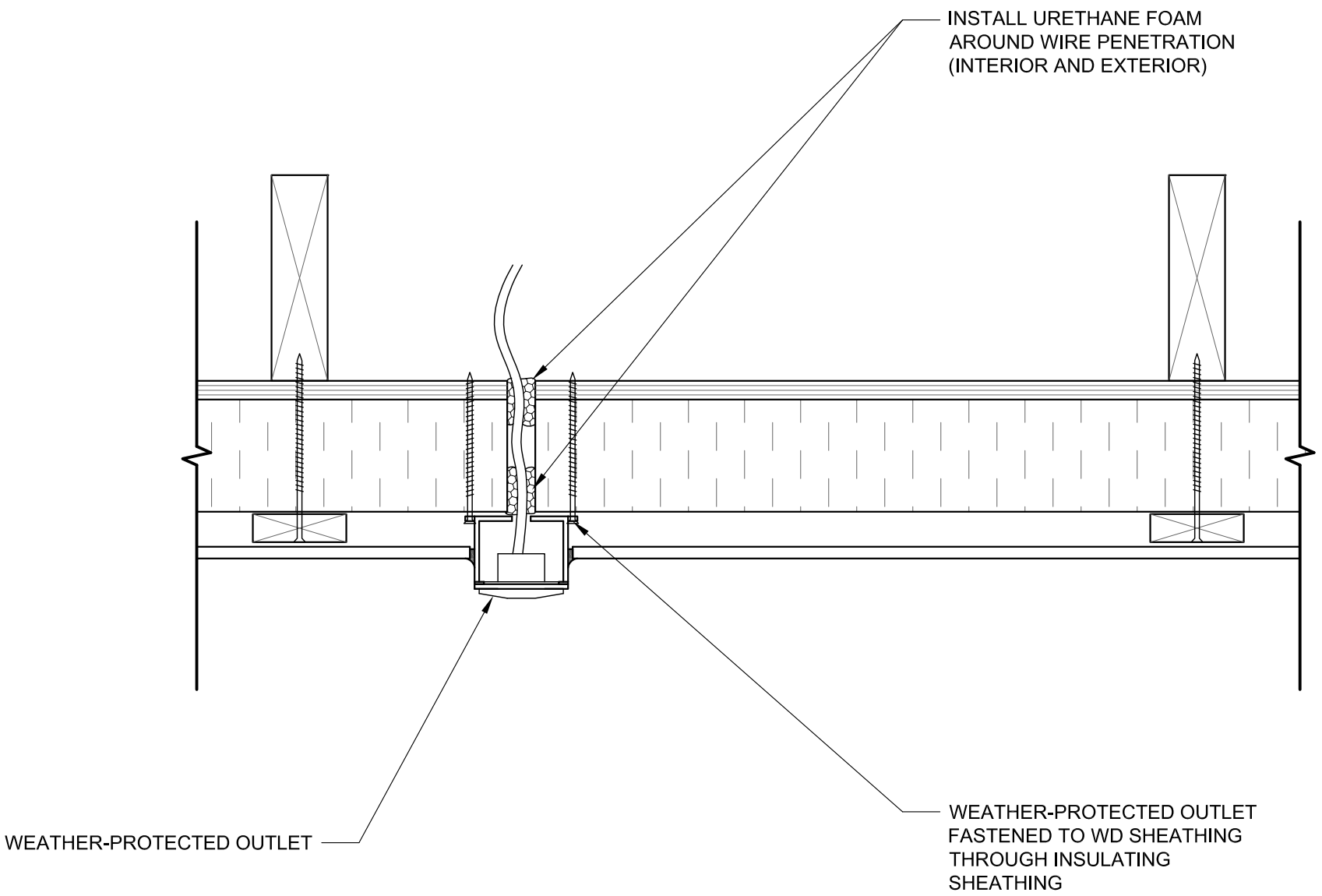


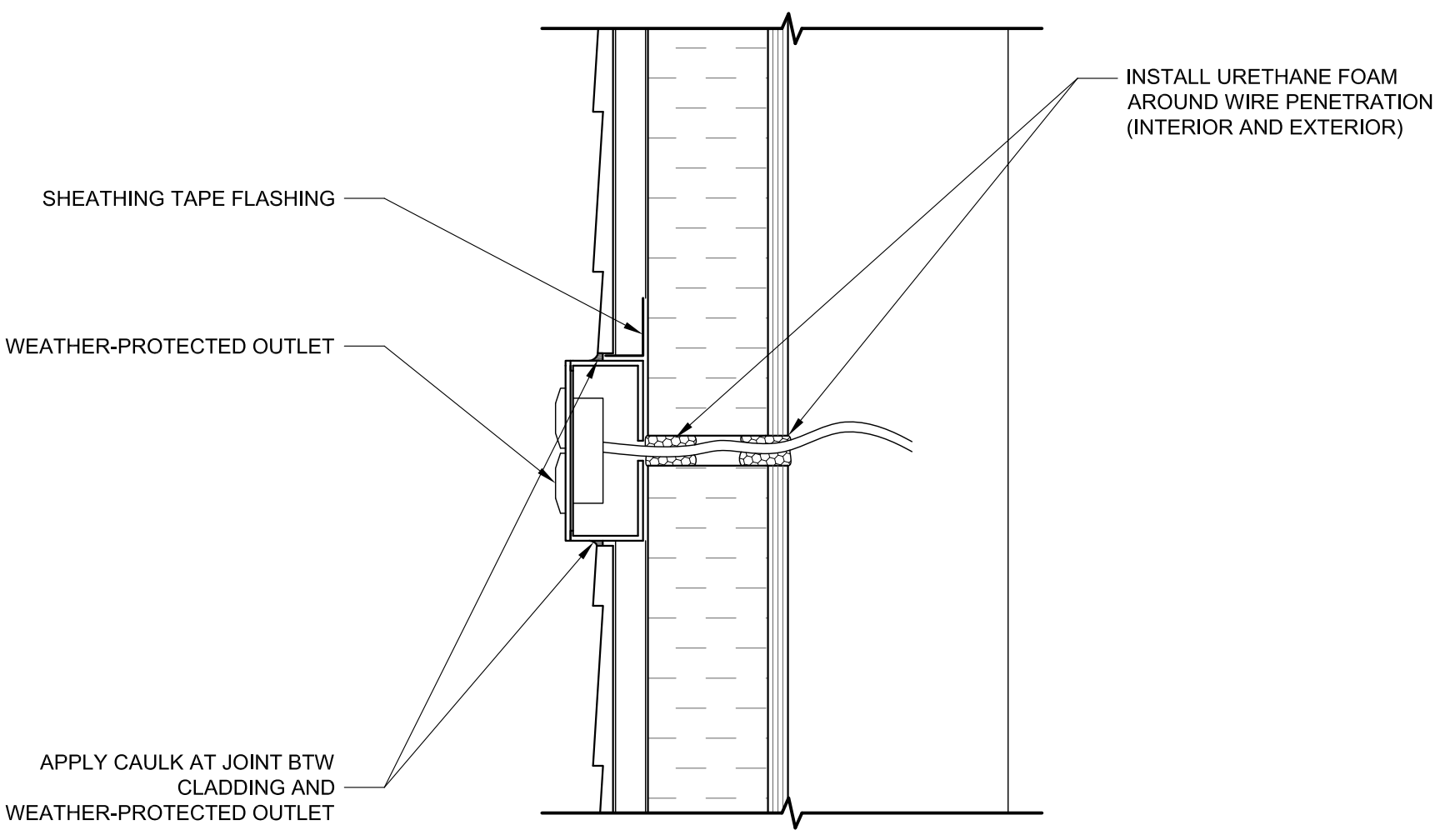
STEP 7

Project:	GREENBRIER
Date:	2009-06-12
Drawing Title:	ENCLOSURE PENETRATION SEQUENCE - DUCT
Drawing File:	2009-06-12 Greenbrier
Drawing Scale:	N.T.S.

Sheet Title:

SK-06





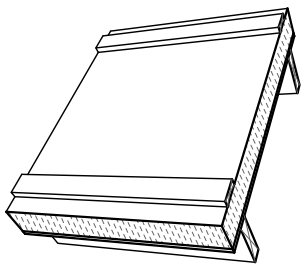
Project:	GREENBRIER
Date:	2009-06-12
Drawing Title:	ENCLOSURE PENETRATION - ELECTRIC BOX
Drawing File:	2009-06-12 Greenbrier
Drawing Scale:	3" = 1'-0"

Sheet Title:

SK-07

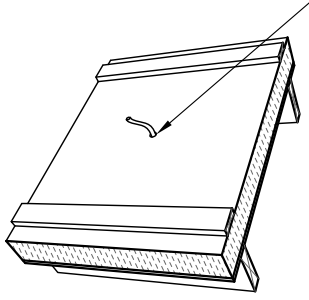
EXTERIOR ELECTRICAL BOX INSTALLATION SEQUENCE

STARTING POINT:
EXTERIOR WALL
WITHOUT CLADDING



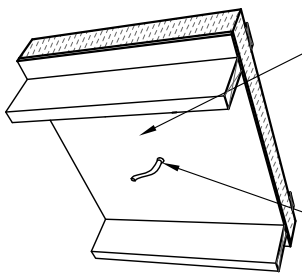
STEP 1

CUT HOLE AND
FEED WIRE
THROUGH



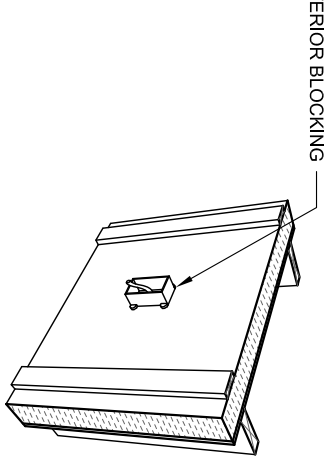
BLOCKING FOR OUTLET
BOX ATTACHMENT
SUPPORT

INSTALL URETHANE
FOAM AROUND WIRE
PENETRATION
(INTERIOR AND
EXTERIOR)



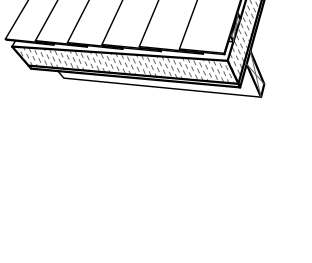
STEP 2

ATTACH OUTLET BOX
FASTEN BACK THROUGH
TO INTERIOR BLOCKING



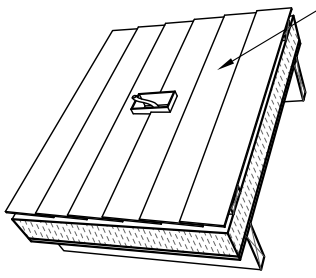
STEP 3

SHEATHING
TAPE FLASHING



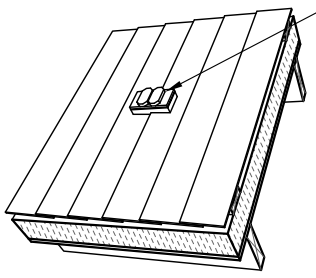
STEP 4

INSTALL CLADDING



STEP 5

INSTALL WEATHER
PROOF COVER

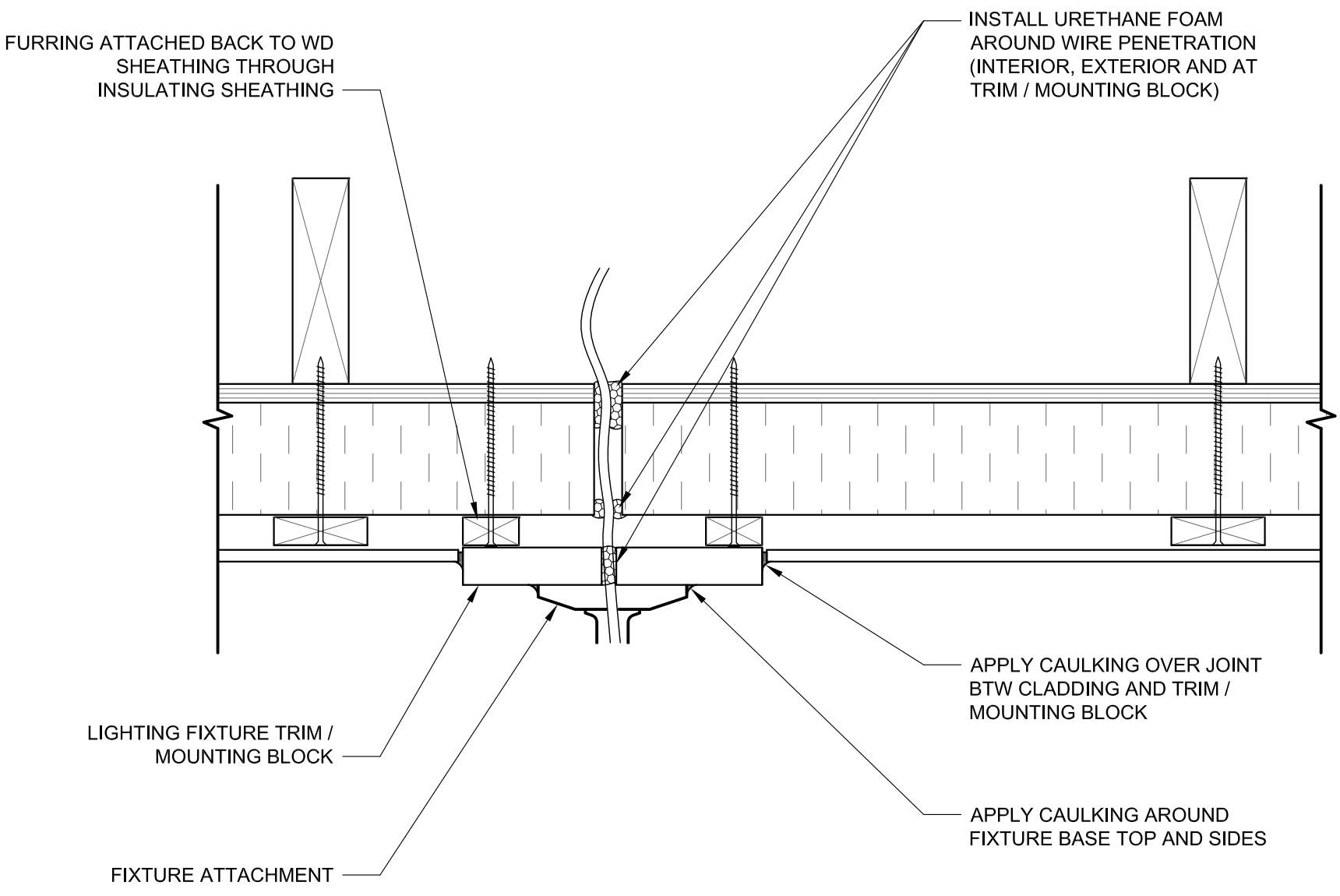


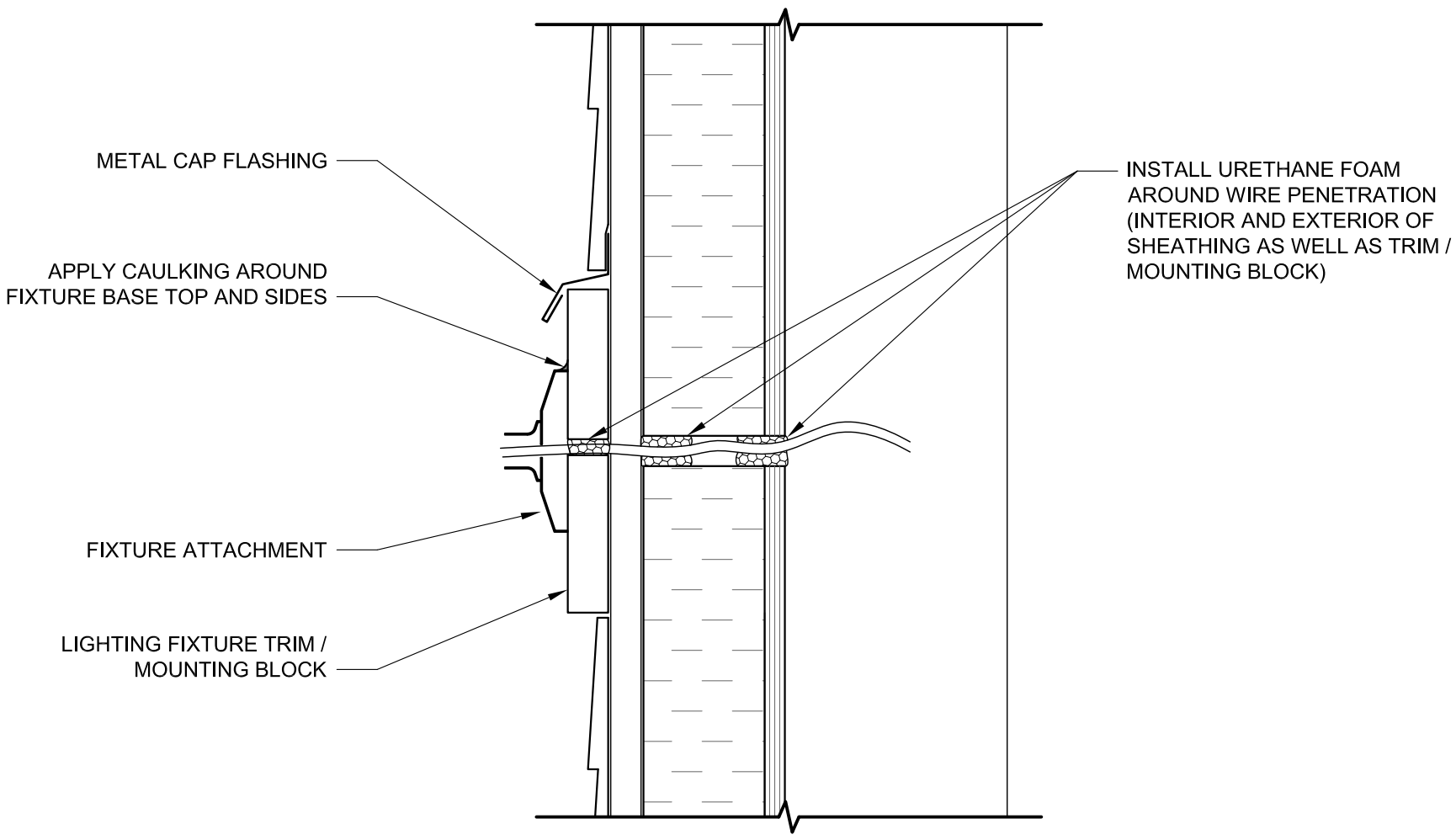
STEP 6

Project:	GREENBRIER
Date:	2009-06-12
Drawing Title:	ENCLOSURE PENETRATION SEQUENCE - ELEC
Drawing File:	2009-06-12 Greenbrier
Drawing Scale:	N.T.S.

Sheet Title:

SK-08





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Drawing File:	2009-06-12 Greenbrier
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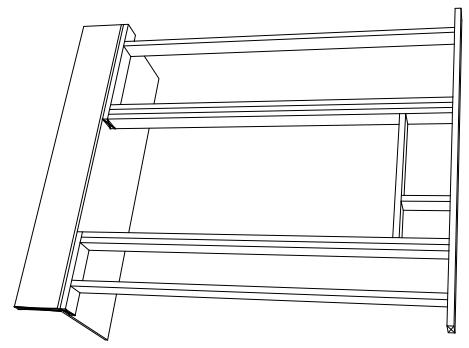
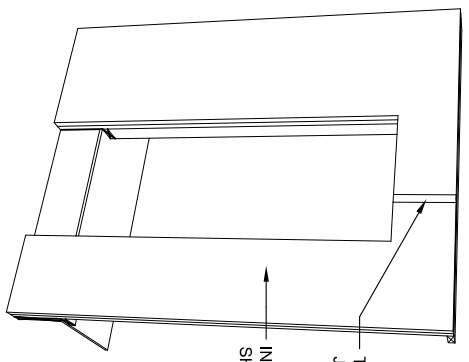
SK-09



STEP 1



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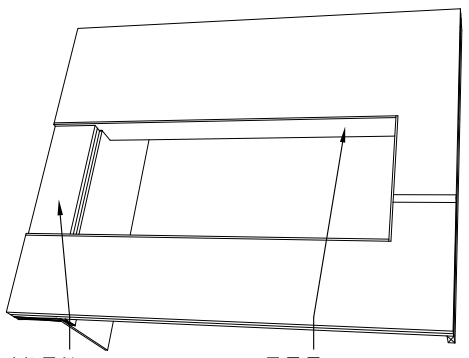

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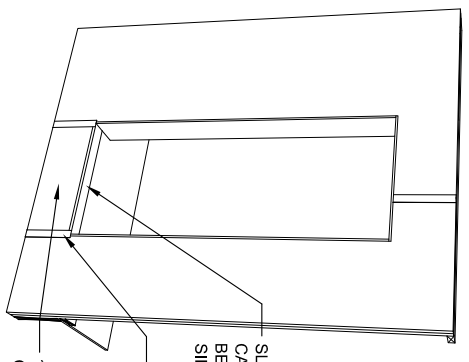

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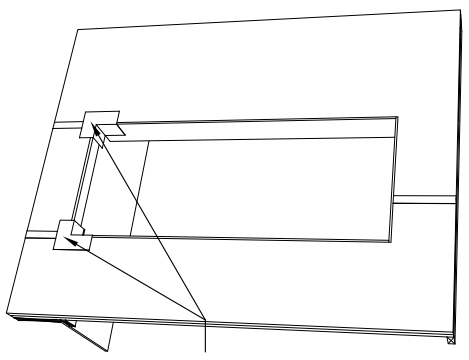

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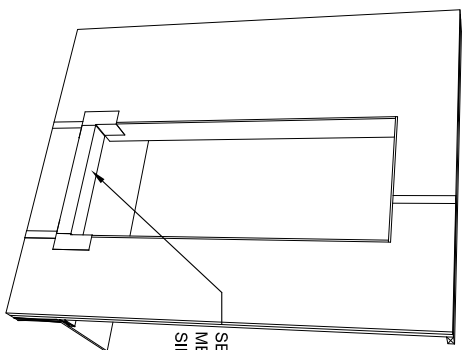

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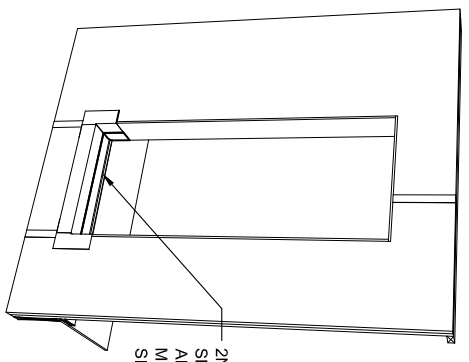

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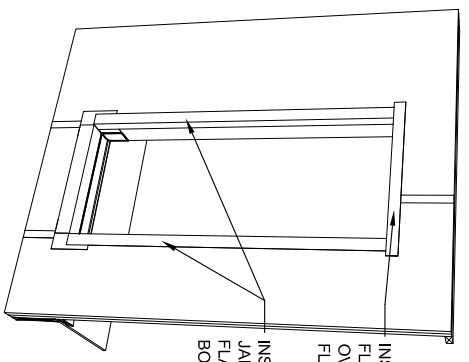

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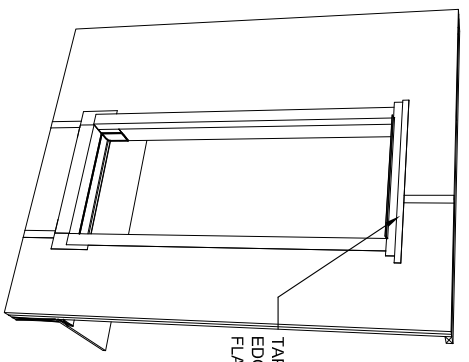

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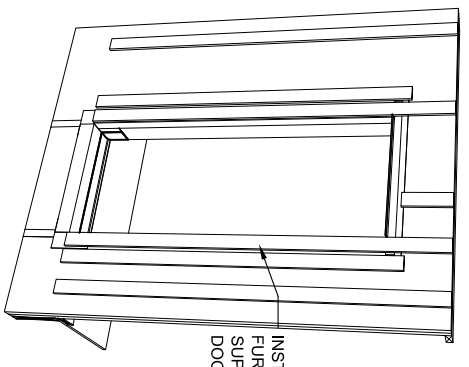

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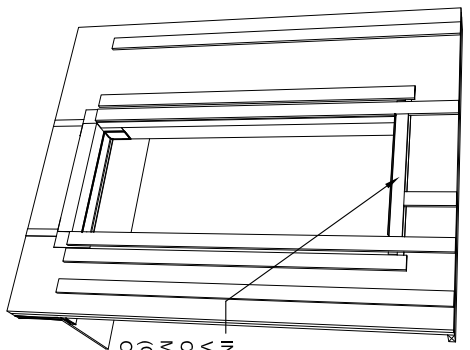

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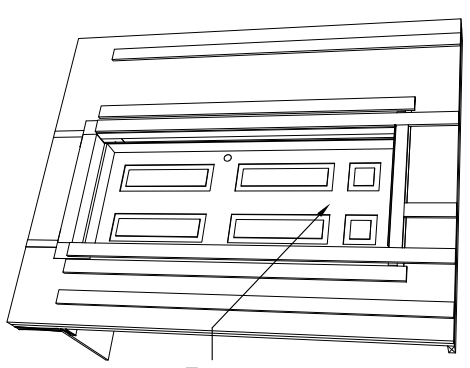

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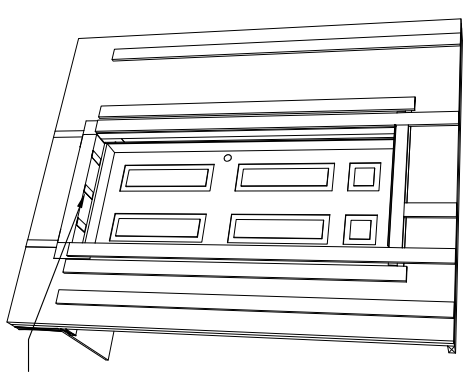

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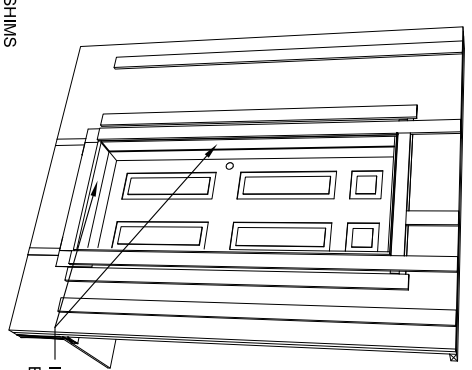

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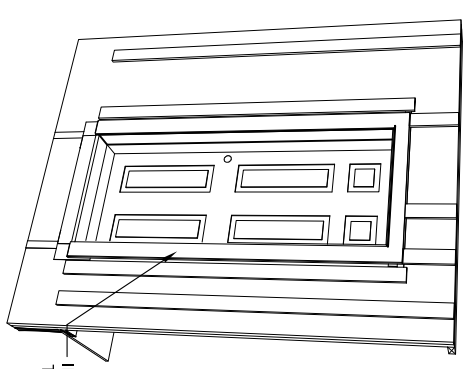
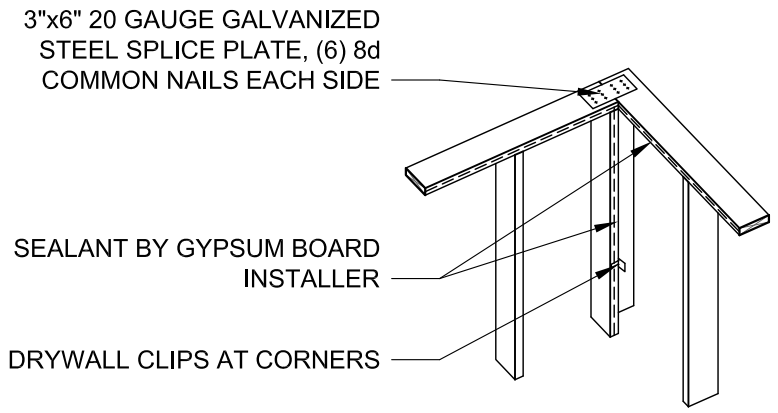


STEP 15

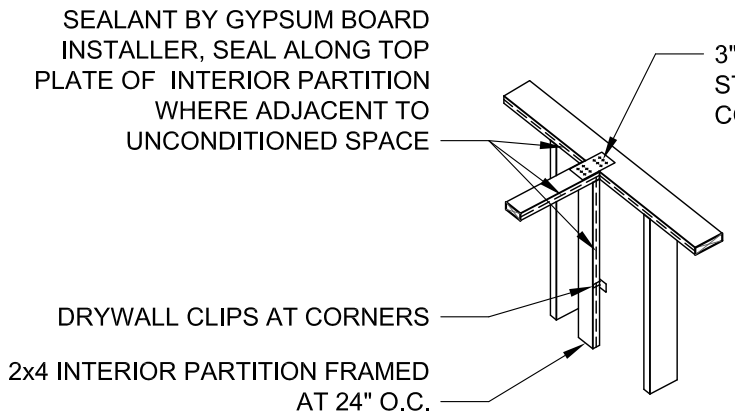
Project: GREENBRIER
Date: 2009-06-12
Drawing Title: DOOR INSTALLATION SEQUENCE
Drawing File: 2009-06-12 Greenbrier
Drawing Scale: N.T.S.

Sheet Title:

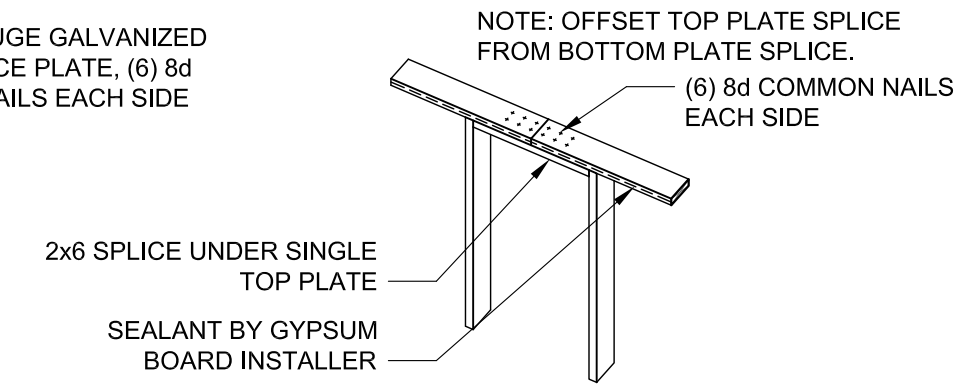
SK-10



10 TWO-STUD CORNER - TOP
N.T.S.



7 SINGLE TOP PLATE AT PARTITION
N.T.S.



4 SINGLE TOP PLATE SPLICE
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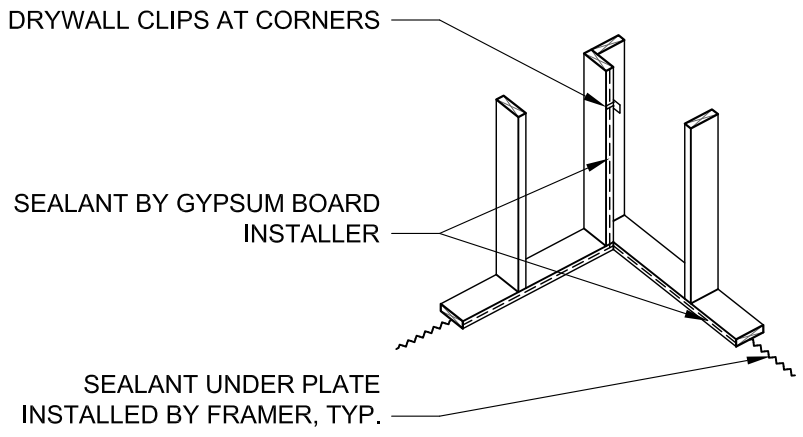

9 TWO-STUD CORNER - BOTTOM
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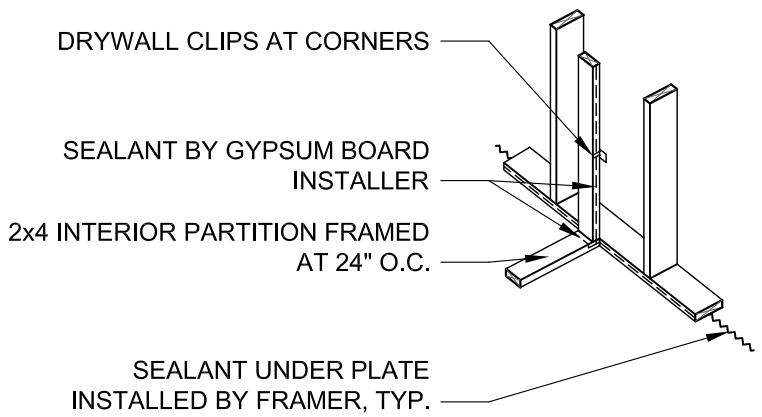

6 BOTTOM PLATE AT PARTITION
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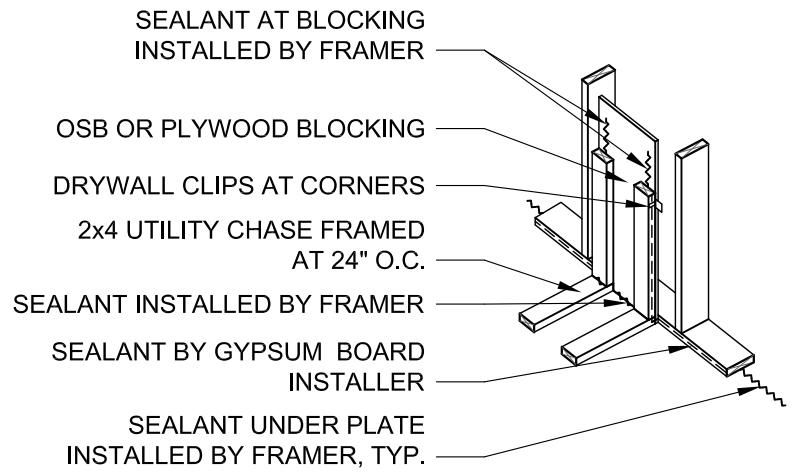
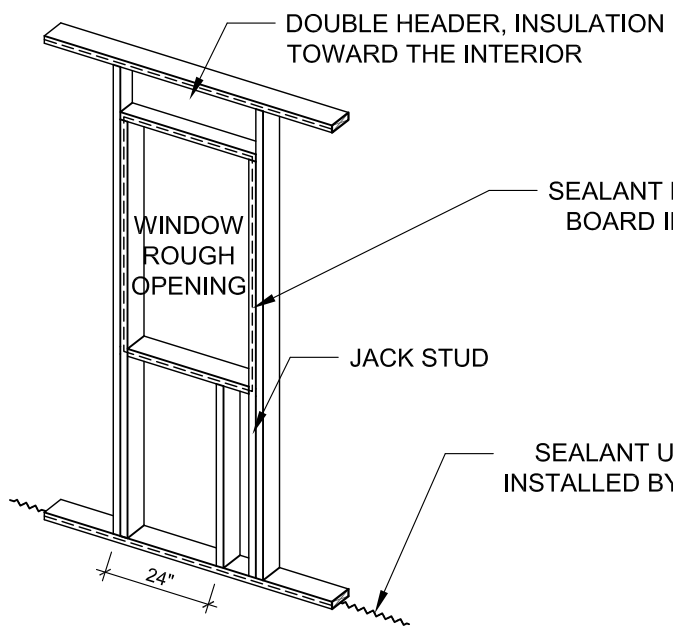
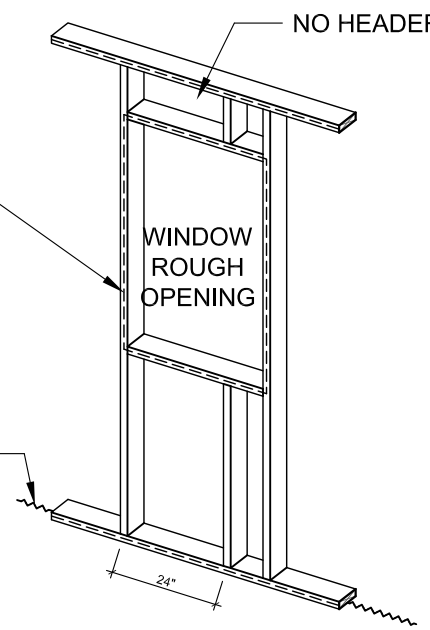


3 CHASE AIR SEALING AT EXTERIOR WALL
N.T.S.



8 OPENING IN LOAD BEARING WALL
N.T.S.



5 OPENING IN NON-LOAD BEARING WALL
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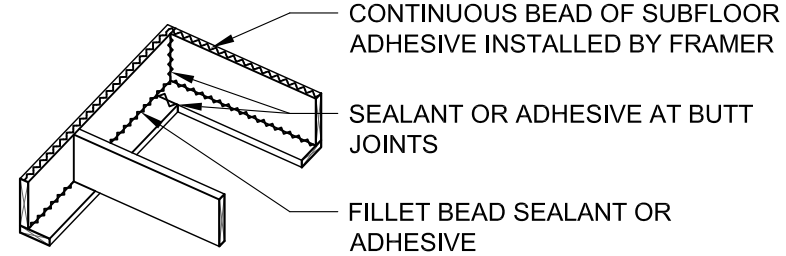
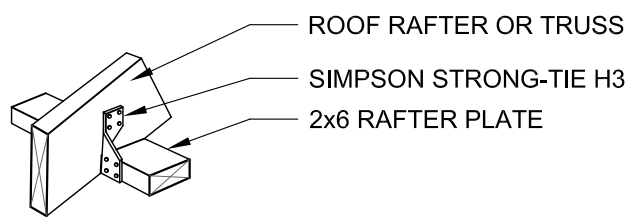


2 RIM JOIST AIR SEALING
N.T.S.



1 ROOF-WALL CONNECTION
N.T.S.

BA-0911: Prototype House Evaluations—Ark Ventures, Greenbrier Prototype

Sheet Title: SK-11

GREENBRIER
2009-06-17 ADVANCED FRAMING AND AIR SEALING DETAILS
2009-06-12 Greenbrier
N.T.S.

Project:
Date:
Drawing Title:
Drawing File:
Drawing Scale:

Appendix D.3.7.3
Sample HVAC Guidance

2009.06.11

James Pepitone
Ark Ventures
46 East Warf Road
Madison, Connecticut 06443

Re: Location of HVAC supply registers

Cc: Keith Tetrealt, HVAC contractor

Dear Jim:

Although, our company has produced many documents to guide HVAC design and installation, we do not presently have a prepared document addressing the placement of supply registers. Nonetheless, this issue is important to building performance. The list below conveys guidance from Armin Rudd and other HVAC experts on our team.

- Ceiling or high wall placement is preferred for supply registers. Ceiling and high wall registers give better distribution and mixing as compared to floor registers.
- Care must be taken to locate registers so that they will not cause comfort complaints. Reasonable care should be taken to avoid blowing air directly on beds. The distribution system should keep air flow velocities below 500 fpm and bedroom supply register flows below 100 cfm.
- Ceiling registers, whether one-way, two-way, or three-way, should have adjustable curved blades. The extra cost is warranted by the ability to adjust flows to control comfort and noise.
- One-way and two-way registers with the adjustable straight blades are acceptable for high wall supplies.
- Floor registers should be avoided where possible as these are easily blocked by furniture and curtains and also tend to collect debris.
- Floor registers are to be avoided in “wet” areas such as bathrooms, kitchens and mud rooms.
- Under cabinet registers tend to provide poor performance and are to be avoided.

Please keep in mind that the distribution system will need to be protected from dust, debris, etc. between rough-in and finish.

If you have any questions, you can reach me as per the contact information below.

Thank you,

Ken Neuhauser

ken@buildingscience.com

978 589 5100 x5279

Appendix D.3.7.4
Mechanical System Design

Table 1: Round Ducts by Room

Room	Duct Size
Basement	3-5
Kitchen	2-6
Dining	1-5
Bath1	1-5
Entry	1-4
Living	1-5
Bath2	1-5
Bed2	1-5
MaCloset	1-4
MaBath	1-5
MaBed	1-6
Sitting	1-4
Computer	1-4
Laundry	1-6
Bed3	1-6
Attic	2-5

Table 2: Supply and Return Trunks

Supply Trunks	**Dimensions**
Combined	13" x 14"
First	9" x 10"
Second	11" x 12"
Return Ducts	
Combined	14" x 15"
First	9" x 10"
Second	10" x 13"
Return Grilles	
First	12" x 14"
Second	14" x 18"

Rhvac - Residential & Light Commercial HVAC Loads
Building Science Corporation
Westford, MA 01886

Elite Software Development, Inc.

Project Report

General Project Information

Project Title:
Project Date: Monday, May 11, 2009

Design Data

Reference City:		Hartford, Connecticut
Building Orientation:		Front door faces North
Daily Temperature Range:		Medium
Latitude:	41	Degrees
Elevation:	19	ft.
Altitude Factor:	0.999	
Elevation Sensible Adj. Factor:	1.000	
Elevation Total Adj. Factor:	1.000	
Elevation Heating Adj. Factor:	1.000	
Elevation Heating Adj. Factor:	1.000	

	Outdoor Dry Bulb	Outdoor Wet Bulb	Outdoor Rel.Hum	Indoor Rel.Hum	Indoor Dry Bulb	Grains Difference
Winter:	2.9	2.14	80%	n/a	72	n/a
Summer:	91.3	73.5	43%	50%	75	31

Check Figures

Total Building Supply CFM:	800	CFM Per Square ft.:	0.223
Square ft. of Room Area:	3,595	Square ft. Per Ton:	2,893
Volume (ft³) of Cond. Space:	32,219		

Building Loads

Total Heating Required Including Ventilation Air:	21,590	Btuh	21.590	MBH
Total Sensible Gain:	11,184	Btuh	82	%
Total Latent Gain:	2,452	Btuh	18	%
Total Cooling Required Including Ventilation Air:	13,636	Btuh	1.14	Tons (Based On Sensible + Latent)
			1.24	Tons (Based On 75% Sensible Capacity)

Notes

Calculations are based on 8th edition of ACCA Manual J.
All computed results are estimates as building use and weather may vary.
Be sure to select a unit that meets both sensible and latent loads.

Load Preview Report

Scope	Has AED	Net Ton	ft.²/Ton	Area	Sen Gain	Lat Gain	Net Gain	Sen Loss	Sys Htg CFM	Sys Clg CFM	Sys Act CFM	Duct Size
Building		1.14	3,164	3,595	11,184	2,452	13,636	21,590	400	800	800	
System 1	Yes	1.14	3,164	3,595	11,184	2,452	13,636	21,590	400	800	800	14x14
Ventilation					340	400	740	1,443				
Zone 1				1,794	4,205	753	4,958	9,902	197	310	310	7x11
1-Basement				896	673	79	752	4,517	90	50	50	1--5
2-Kitchen				305	1,617	61	1,678	1,390	28	119	119	1--7
3-Dining				144	578	68	646	1,407	28	43	43	1--4
4-Bath1				24	136	30	166	484	10	10	10	1--4
5-Entry				159	400	23	423	802	16	30	30	1--4
6-Living				266	801	492	1,293	1,302	26	59	59	1--5
Zone 2				1,801	6,639	1,299	7,938	10,245	203	490	490	9x12
7-Bath2				84	219	16	235	334	7	16	16	1--4
8-Bed2				169	641	240	881	872	17	47	47	1--5
9-MaCloset				52	0	0	0	0	0	0	0	0--0
10-MaBath				115	247	54	301	727	14	18	18	1--4
11-MaBed				272	1,144	482	1,626	1,481	29	84	84	1--6
12-Sitting				92	516	52	568	1,357	27	38	38	1--4
13-Hall				113	33	16	49	163	3	2	2	1--4
14-Computer				107	311	40	351	733	15	23	23	1--4
15-Laundry				64	927	45	972	1,033	21	68	68	1--6
16-Bed3				157	1,030	286	1,316	1,690	34	76	76	1--6
17-Attic				576	1,571	68	1,639	1,855	37	116	116	1--7

Total Building Summary Loads

Component Description	Area Quan	Sen Loss	Lat Gain	Sen Gain	Total Gain
Harvey Triple: Glazing-Harvey Triple Pane Vinyl, light color drapes with medium weave with 50% coverage, u-value 0.2, SHGC 0.19	370.6	5,122	0	3,154	3,154
11P: Door-Metal - Polyurethane Core	96	1,889	0	718	718
15B0-20sf-6: Wall-Basement, , R-20 board insulation to floor, no interior finish, 6' floor depth	940	2,229	0	120	120
R-37: Wall-Frame, , R-21 batt, R-19.5 foam	2330.9	4,350	0	799	799
R-37: Part-Frame, , R-21 batt, R-19.5 foam	316.6	313	0	417	417
R-52: Roof/Ceiling-Under Attic with Insulation on Attic Floor (also use for Knee Walls and Partition Ceilings), Custom, R38 batt, R-21.7 foam (Greenbrier)	1003	1,317	0	1,358	1,358
R-45: Roof/Ceiling-Roof Deck (roofing, wood, insulation) or SIP Panels Supported on Beams, Custom, batt in rafter (R-32)	221	336	0	113	113
polyiso on deck (R-19.5)					
21B-28: Floor-Basement, Concrete slab, any thickness, 2 or more feet below grade, R-3 or higher insulation installed below floor, any floor cover, shortest side of floor slab is 28' wide	896	929	0	0	0
20P-38: Partition Floor (STD=26.3, WTD=59.1)-Over open crawl space or garage, Passive, R-38 blanket insulation, any cover	328	581	0	258	258
Subtotals for structure:		17,066	0	6,937	6,937
People:	6		1,200	1,380	2,580
Equipment:			0	1,800	1,800
Lighting:	0			0	0
Ductwork:		0	0	0	0
Infiltration: Winter CFM: 41, Summer CFM: 41		3,081	852	727	1,579
Ventilation: Winter CFM: 19, Summer CFM: 19		1,443	400	340	740
Total Building Load Totals:		21,590	2,452	11,184	13,636

Check Figures

Total Building Supply CFM:	800	CFM Per Square ft.:	0.223
Square ft. of Room Area:	3,595	Square ft. Per Ton:	2,893
Volume (ft³) of Cond. Space:	32,219		

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Total Heating Required Including Ventilation Air:	21,590	Btuh	21.590	MBH
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Total Cooling Required Including Ventilation Air:	13,636	Btuh	1.14	Tons (Based On Sensible + Latent)
			1.24	Tons (Based On 75% Sensible Capacity)

Notes

Calculations are based on 8th edition of ACCA Manual J.
All computed results are estimates as building use and weather may vary.
Be sure to select a unit that meets both sensible and latent loads.

Appendix D.3.7.5
Water Management Memo

2009.06.14

James Pepitone
Ark Ventures
46 East Warf Road
Madison, Connecticut 06443

Re: Flashing to address before cladding: 1) roof-wall, 2) rake return, 3) drainage plane using face of foam, 4) enclosure penetrations, 5) exterior doors with thick exterior insulation

Cc: Betsy Pettit, Building Science Corporation

Dear Jim:

I am aware that the cladding of your high performance prototype is to be conducted very soon. Since the drainage plane is behind the cladding, it is imperative that flashing and drainage plane integration is properly executed throughout before the cladding is installed. As you had noted, the sequence of the exterior insulation installation and the location of the drainage plane at the face of the foam sheathing both clashed with your framing contractor's habitual practices relating to flashing and drainage planes. There are some areas where flashing details will need to be remediated.

There are also areas of work occurring more recently that may require unfamiliar detailing to successfully integrate the drainage plane and maintain air barrier continuity.

Accompanying this letter are several sketches that show flashing details and critical installation sequences. The text below also attempts to explain other important drainage plane measures not addressed in sketches.

Roof flashing

Roof-Wall Connection

We have previously discussed the problem observed at the intersection of the bonus room roof and the house wall. The step flashing had been installed prior to the insulating sheathing resulting in a situation where the flashing drains behind the insulating sheathing. The remediation for this involves cutting and lifting roof shingles to allow a transition membrane to be adhered to the roof deck and face of the insulating foam sheathing. This membrane should extend a minimum of 6" over the roof deck and 6" up the wall. The roofing paper can be returned over the membrane. Metal step flashing is then installed over the transition membrane at the face of the insulating foam sheathing. Step flashing is to be woven into the roof shingles as these are reinstalled. The top 2" of the top leg of the step flashing should be covered with a flashing membrane. Tape is then applied over the top edge of both the flashing membrane covering step flashing and the top edge of the transition membrane running up the wall from the roof.

Please refer to SK-04 which represents the flashing remediation detail.

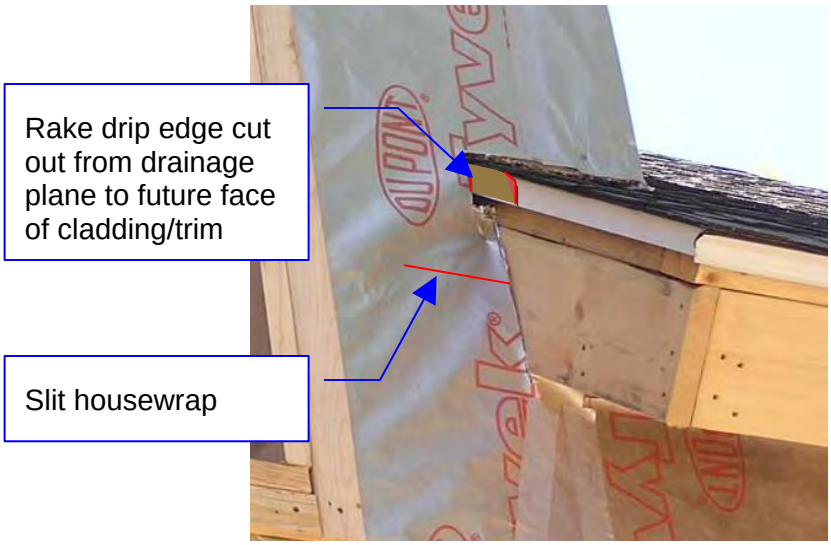
Roof Rake Return

The roof rake return presents another situation where the flashing is not integrated into the drainage plane and, therefore, not at the correct location. Also at this location, there is un-flashed openings in the drainage plane. Refer to Figure 1 below.

Figure 1 - Roof Rake Return

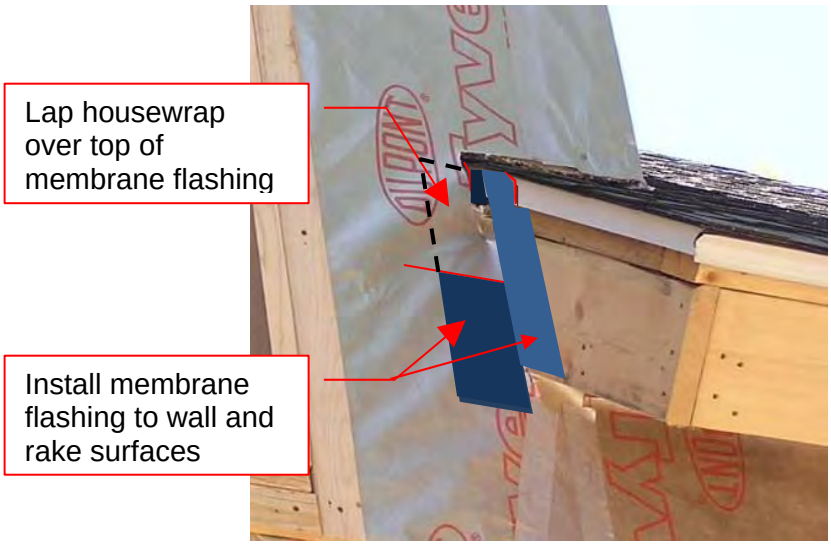
There should be an inside corner flashing as well as a straight flashing at the roof-wall interface extending over the inside corner to project this area. Recommendations for drainage plane remediation for this situation is described and illustrated below.

1. **Cut rake drip edge to accommodate inside corner flashing**



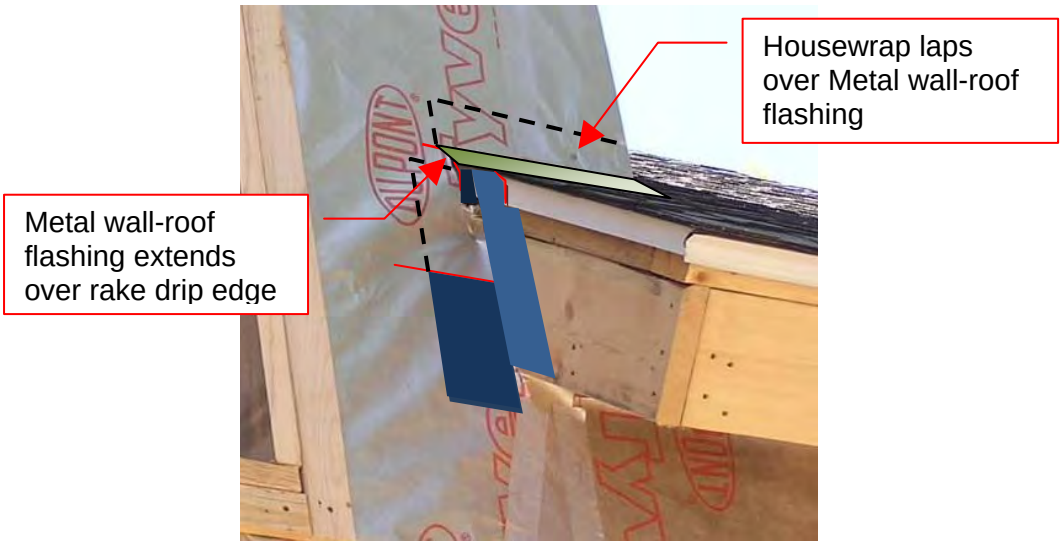
- **Cut rake drip edge flush with drainage plane to let in inside corner flashing.**
- **Slit housewrap at location shown to allow shingle lapping of drainage plane components.**

2. Install inside corner flashing



- **Install single piece of membrane flashing to cover inside corner.**
- **Membrane flashing on wall is installed beneath housewrap above slit in housewrap and over housewrap below slit in housewrap.**

3. Install metal flashing at wall-roof



- **Install metal flashing at roof-wall. Top leg under housewrap.**
- **Bottom leg of flashing loose on roof to allow water to drain beneath it.**
- **Flashing extends past rake slightly (~1”) to protect inside corner and cover cut in rake drip edge.**

4. **Tape slits in housewrap**

At rake returns where you do not have housewrap, tape the top edge of flashing to the foil-facing of the insulating sheathing. See discussion of foil facing as drainage plane below.

Foil Facing as Drainage Plane

When the foil facing of the exterior insulation is used as the drainage plane (i.e. where there is no Therma Wrap™ installed over the foil-faced foam sheathing) the top edge of metal- and membrane flashings must be taped to the foil facing. Since the foil facing cannot be lapped shingle style over flashings, these need to be integrated into the drainage plane using durable tapes. With metal flashings it is good practice to use an adhered membrane strip over the top edge and then tape over the top edge of the membrane strip. We have found that self-adhered membranes can curl away from the substrate slightly at the edges. This is generally not a concern for the side and bottom edges, but a top edge curling away from the substrate could form a dam interrupting the drainage flow.

Enclosure Penetrations

Penetrations through the enclosure – such as for electrical services, vent ducts, or pipes – present a challenge both to air barrier continuity and drainage plane function. While exterior electrical fixtures, fixture mounting blocks and duct/pipe penetrations are typically flashed to the cladding, the critical flashing and water management details need to be implemented at the penetration through the drainage plane which occurs behind the cladding.

Accompanying sketches, SK-05 and SK-06 represent water management details for duct/vent pipe penetrations. Sketches SK-07 and SK-08 show water management details for exterior electric outlets. Sketch SK-09 shows water management details for electric wire penetration and a trim mounting block. Certainly these do not exhaustively represent enclosure penetrations encountered in the Greenbrier project. Still, I expect that they represent a wide enough range of conditions such that conditions encountered in the field will be at least analogous to those represented in the Sketches. If you encounter conditions for which the drawings do not provide adequate guidance, please let me know.

Exterior Doors with Thick Exterior Insulation

The use of thick exterior insulation ("*outsulation*") presents a challenge to standard door installation practice. Issues of special concern for installing a door in this situation are 1) the drainage pan, 2) threshold support, 3) trim extension, and 4) head flashing. For reasons of door swing and threshold support, a door is typically installed in plane with the wall framing even when windows are projected out to be roughly in plane with the outer surface of the wall. This placement of the door will present challenges different than those already resolved for the window openings. SK-10 shows a recommended installation sequence for an exterior door in a wall of thick exterior insulation.

Installing a drainage pan or pan flashing beneath an exterior door is always recommended. Thick exterior insulation often requires two or more runs of flashing, lapped shingle style, in order for the flashing to be under the door and extend fully to the drainage plane. In order for the pan flashing to have a drainage gap and be able to drain to the outside, the threshold of the door must be supported on plastic shims.

There are many acceptable methods for providing threshold support. For this project, a threshold support built up of two layers of 2x framing lumber will match the exterior insulation thickness. It would also be acceptable to use a layer of 1 ½" XPS to space a single layer of 2x threshold support.

A three-sided trim box is needed to extend the exterior jambs to the jamb trim and to bridge between the door head and the head casing trim. Unless the door is directly beneath a sheltering overhang (e.g. if the door is in a deeply recessed opening or porch) it will need a means to drain the drainage cavity above the door head. This drainage can be provided by creating a gap (~1/8") along the length of the door head extension between this and the head casing. Alternately, or in addition to this, a metal head flashing can be used to direct water from the drainage plane surface out over the head casing. It is important that the head flashing have a positive slope to the outside and that it extend past the ends of the head casing..

If you have any questions, you can reach me as per the contact information below.

Thank you,

Ken Neuhauser

ken@buildingscience.com

978 589 5100 x5279

Appendix D.3.7.6
Quality Control Checklist

!Insert Logo Here

Builder Name:	Ark Ventures, James Pepitone
Project:	Greenbrier Prototype
Lot Number:	

BSC Building America Quality Control Checklist

Part 1 - Pre-drywall Inspection

Foundations		Completion Verified
A drainage plane must be provided with sub-grade drainage for below grade spaces	ref: BSC Information Sheet 101	☐
Exterior or interior perimeter footing drainage system is installed		☐
Drainage membrane or draining insulation is installed around below grade walls		☐
Free-draining backfill is installed over perimeter drainage		☐
Sub-slab gravel bed is connected to perimeter drainage		☐
Perimeter drainage is connected to storm water drain or sloped to daylight		☐
A capillary break separating the entire foundation from the soil must be provided	ref: BSC Information Sheet 101	☐
A below-slab capillary break has been installed		☐
A capillary break has been installed on the foundation wall and footings (horizontal and vertical surfaces)		☐
Use soil gas resistant construction techniques	ref: BSC Information Sheet 110	☐
Floor openings, concrete joints, and foundation checks have been sealed against gas entry		☐
Floor drains and sumps have been sealed against gas entry		☐
Passive vent stack with "T" in sub-slab gravel bed has been installed		☐

Pre-Cladding		Completion Verified
Protect construction materials from moisture before installation	ref: n/a	☐
Keep all building materials dry during storage on-site		☐
Separate wood from concrete or masonry with appropriate capillary break	ref: n/a	☐
Sill plates separated from foundation wall with capillary break		☐
A drainage plane must be provided that is integrated with flashings	ref: BSC Information Sheets 300, 302	☐
Drainage plane has been installed in a continuous manner		☐
Sheet material has been properly lapped to drain water		☐
All flashing elements specified have been correctly installed		☐
Drainage plane overlaps flashing or connected by a transition membrane		☐
A drainage plane must be accompanied by a drainage space	ref: BSC Information Sheet 300	☐
Materials to create drainage gap have been installed as specified		☐
Intentional drainage spaces are clear of construction debris		☐
Subsill flashing: windows and doors must be "pan-flashed"	ref: BSC Information Sheet 301	☐
All windows and door openings are "pan-flashed"		☐
Pan-flashing installed with end dams and positive slope towards the exterior		☐
Flashing materials are correctly lapped		☐
Reservoir claddings must be "uncoupled" from wall assemblies	ref: BSC Information Sheet 304	☐
Reservoir claddings (such as brick, stucco and fiber cement) are back-ventilated with min. 1/4" ventilation space (1" for brick) or are installed over a moisture-tolerant and vapor impermeable material		☐
A continuous air barrier must be provided	ref: BSC Information Sheets 403, 404, 405, 406	☐
Air sealing provided between bottom plates and floor deck		☐
Rim joists areas are caulked or sealed with sprayed foam		☐
Carrying beams running to outside walls and beam pockets are sealed		☐
Perimeter of windows and doors are sealed on the interior side with low-expansion foam or sealant		☐
Bathtubs on exterior walls have draftstopping materials installed behind tub		☐
Fireplace enclosures have draftstopping material installed to line enclosure		☐
Cantilevered floors (including floors over attached garages) are sealed with spray-foam or sealant as appropriate		☐
Bay and Bow Windows are sealed		☐
Walls and ceilings separating attached garages from living space are properly sealed by: installing gas-proof membrane, taping gypsum board, and sealing all penetrations		☐
Chimney chases and interior soffits running to exterior walls have been draftstopped and air sealed		☐
Electrical wiring or outlets on exterior walls and other penetrations have been sealed		☐
Only airtight-rated recessed lights installed in insulated ceilings		☐
Vapor control of wall, roof and foundation assemblies must be provided as specified	ref: BSC Information Sheet 311	☐
Materials with vapor permeability characteristics matching the products specified for each assembly in the construction documents have been installed		☐

Pre-insulation		Completion Verified
Wet rooms have water resistant flooring	ref: BSC Information Sheet 305	☐
Water resistant flooring installed in bathrooms		☐
Water resistant flooring installed in laundry rooms		☐
Water resistant flooring installed in mud rooms		☐
Install floor drain and drain pan where water heater is installed over living space		☐
Paper faced gypsum board should not be used in multi-family party walls or any part of the building constructed before the roof is applied	ref: n/a	☐
Plumbing should not be located in exterior walls, floors over unconditioned space, insulated ceilings, or in unconditioned spaces	ref: n/a	☐
Make plumbing easy to inspect and repair and insulate plumbing pipes to keep them warm (above dewpoint temperatures)	ref: BSC Information Sheet 305	☐
Access panels for plumbing inspection have been installed where specified on plans.		☐
Pipe insulation has been installed on exposed hot and cold runs not located in walls.		☐

Pre-drywall		Completion Verified
Install insulation to meet HERS Insulation Installation Grade 1	ref: BSC Information Sheet 501	☐
Few installation defects, only very small gaps around wiring, electric outlets, etc. and incomplete fill amounts to 2% or less. Gaps running clear through the insulation amount to no more than 2% of the total surface area covered by the insulation. Wall cavity insulation is enclosed on all six sides and in substantial contact with the sheathing material on at least one side (interior or exterior) of the cavity.		☐
ENERGY STAR Thermal Bypass Inspection Checklist has been completed		☐

!Insert Logo Here

Builder Name:	Ark Ventures, James Pepitone
Project:	Greenbrier Prototype
Lot Number:	

BSC Building America Quality Control Checklist

Part 2 - Finish Inspection

Mechanical System Inspection		Completion Verified
Sealed Combustion Equipment	ref: BSC Information Sheet 601	☐
Sealed combustion equipment provided as specified		☐
Sealed combustion equipment installed as specified		☐
Ventilation system design must have the capacity to meet the requirements of ASHRAE 62.2 and must be commissioned at 60% of ASHRAE 62.2	ref: BSC Information Sheet 610	☐
Ventilation system provided and installed as specified		☐
Ductwork to inside and outside are properly installed and connected		☐
Ventilation system control has been installed and commissioned as specified		☐
Air filter housings must be airtight to prevent bypass or leakage		☐
Interior spaces must be air pressure balanced (less than 3 Pascals between all spaces). Transfer grilles or jump ducts to be provided for any closed room without a return grille (except bathrooms, closets, pantries and laundry rooms)	ref: BSC Information Sheets 604	☐
Transfer grilles have been installed where indicated on the plans		☐
Duct systems properly sized and placed	ref: n/a	☐
Duct runs are placed where indicated on the drawings or layout has been revised with mechanical designer		☐
Conditioning system design loads must be determined according to ACCA Manual J and equipment must be sized using ACCA Manual S	ref: n/a	☐
Air conditioning system supplied and installed as specified		☐
Part load dehumidification must be provided in IRC Zones 1 and 2 ("Hot-Humid Climates") for buildings and units less than 2000 square feet	ref: BSC Information Sheet 620	**NA**
If included in the design, part-load dehumidification system has been provided and installed as specified		NA
Dehumidification system controls have been installed and commissioned as specified		NA
Ducts should be located inside the enclosure air barrier.	ref: BSC Information Sheet 602	☐
If located outside, leakage must be limited to 5% of the total air handling system rated air flow at high speed (nominal 400 CFM per ton) determined by pressurization testing at 25 Pa.		☐
Building cavities not used as part of the forced air supply or return system		
Supply and return ductwork sealed to be airtight	ref: BSC Information Sheet 603	☐
Ductwork has been air sealed at joint locations and equipment connections		☐
Ductwork is sealed to supply and return boots		☐
Protect ductwork during construction	ref: n/a	☐
Ductwork rough-in protected from construction debris		☐
Supply and return duct boots have been covered during interior finishing		☐
Exhaust vents and intake ducts correctly placed	ref: BSC Information Sheet 606	☐
Exhaust and intake ducts installed where indicated on plans		☐
Clothes dryers vented outdoors		☐

Landscaping		Completion Verified
Provide strips around buildings free of planting and organic mulch	ref: n/a	☐
A 24" wide strip free of organic mulch and planting has been provided around buildings		☐
Bushes and trees are at least 36" away from building		☐
Site surface water is controlled by appropriate grading and landscape measures	ref: BSC Information Sheet 101	☐
Grade on all sides of building slopes away from building		
Patios and decks are installed lower than the finished floor and slope away from the building		☐
Garage floor is lower than the finished floor and slopes away from the building		☐
Driveway is lower than garage floor and slopes away from the building		☐
Finished grade is lower than main floor and slopes away from the building		☐
Stoops, porches and walkways are lower than the main finished floor and slope away from the building		☐

Exterior Finish		Completion Verified
Separate wood from concrete or masonry with appropriate capillary break	ref: n/a	☐
Deck and stair posts held off concrete with metal brackets or other non-organic spacer		☐
Detail deck to house connection (including ledger to wall connection) to shed water away from house and to allow natural drying of assembly		☐
Install exterior flashing and drainage	ref: BSC Information Sheet 302	☐
Step flashing at all roof/wall intersections and terminated with "kickout" flashing or		☐
Gutters and downspouts or other roof drainage system has been installed		
Select building materials that are insect resistant (steel framing, concrete framing, treated wood framing and sheathing, plastic or plastic composite cladding, cement or fiber cement cladding, brick or stucco cladding)	ref: n/a	☐
Insect resistant materials are installed where specified on the plans		☐

Pre-occupancy		Completion Verified
Paper faced gypsum board should not be used in "wet areas"	ref: BSC Information Sheet 407	☐
Paper-faced gypsum board not used in bathrooms, showers, laundry rooms and mudrooms		☐
Raise gypsum board minimum of 1/2" above concrete slab		☐
An environmental separation between attached garages and living space must be provided, no air handling equipment located in garage	ref: BSC Information Sheet 305	☐
Walls and ceilings separating attached garages from living space are properly sealed by: installing gas-proof membrane, taping gypsum board, and sealing all penetrations		☐
Washers should be equipped with single throw shut off valves	ref: BSC Information Sheet 305	☐
Washing Machine connections are equipped with a single throw shut off valve		☐
No carpet in areas prone to get wet: bathrooms, laundry rooms, kitchens, and entryways	ref: BSC Information Sheet 305	☐
No carpet has been installed in bathrooms, laundry rooms, kitchens, and entryways		☐
Vapor open design of construction assemblies maintained	ref: BSC Information Sheet 311	☐
Vapor-permeable finish materials that do not interfere with vapor open design have been installed		☐

Appendix D.3.7.7
Zero Energy Challenge

PARTICIPANTS
ABOUT THE CHALLENGE
ZERO ENERGY HOMES
WHAT'S NEW
CT ZEC HOME

CONNECTICUT ENERGY EFFICIENCY FUND
www.CTEnergyInfo.com

Participant:
Ark Contractors

THE HOMES AT greenbrier a new sustainable green community

Applicant: James Pepitone
Project Address: Greenbrier - Williams Rd., Oakdale, CT
Bdrms./Sq. Footage: 3 BD, 2800 sq ft
Builder Website: arkventures.com, arkgreenbrier.com
Project Photos: View Project Photos

PROJECT OVERVIEW | BUILDER BIO | PROJECT SPECIFICATIONS

This Zero Energy finalist home located in Oakdale, CT is also the Builders Association of Eastern CT Green Showcase Home of the year. The Greenbrier model home is the first in the Northeast and Connecticut and the second in the USA to be awarded the Emerald level of Certification by NAHB. The home has received certification as a DOE Build America prototype and an ENERGY STAR® certified home.

Building Science recommends a formula of 5,10,20,40,60; R-5 triple glazed Harvey windows, R-10 under the slab, R-20 basement walls, R-40 exterior walls and an R-60 roof. The resulting systems designed residence concentrates first on the enclosure and second on mechanical systems. Anchor insulation used a variety of materials in order to attain the highest R-values with the least financial strain – attainable and sustainable. A high performance healthy home uses only a small amount of energy. M&W Sheetmetal designed the 2800 sq ft home so it can be heated on the coldest day using less than 30,000 btu of energy and can be cooled using only 1.5 tons of AC.

A major portion of the insulation is attached outside of the frame to reduce thermal bridging and moisture build up in the wall cavity. Hunter Panel (Portland, ME), supplied a 5.5" Cool Vent Polyiso roof panel that provides for air circulation above the insulation and below the roof. The exterior wall system includes 3" of foil faced and sealed Polyiso and a 1" air chamber between the Hardplank siding and the insulation.

Norwich Overhead Door installed eco-insulated garage doors. Stock supplied the ENERGY STAR® Therma-tru™ exterior doors and UBS supplied MoistureShield® decking and the Mohawk engineered oak hardwood floor. Osterman Gas supplied the Rinnai boiler and Empire direct vent condensing fireplace. Moffit painting used Benjamin Moore® Eco Spec® paint and The Kitchen Guy supplied KraftMaid® cabinets and granite counters.

Waldo Renewable will be installing a 10 kW PV system.

Sticking to our goal of attainable and sustainable, we have determined that the HVAC system with the fastest payback and most efficient back up is the Hybrid Air Source Heat Pump. Like a hybrid car, electric is used to generate heat down to 40° F when a 98% efficient, fully modulating, gas fired direct vent furnace will kick in to supplement the heat pump. Hot water is supplied by a wall hung, direct vent, instant on gas boiler.

Eastern CT Flooring provided the eco bath floor tiles. Budnick plumbing installed a manifold home run water distribution system and Brite Way Electric installed the ENERGY STAR® Fixtures supplied by Major Electric. Kohler® and The Granite Group supplied the dual flush toilets and low flow faucets. Goodale Sheetrock nailed and glued drywall to the exterior frame to assist in preventing air infiltration. A rain barrel is used to collect rainwater and a rotating barrel is provided for composting. Bruno Hayn originated the passive solar heating and cooling aspects of the systems-designed home. ENERGY STAR® appliances were supplied by Coogan and Gildersleeve. Cyclone Home systems installed the alarms

and central vacuum. CRS completed the site work after CTF Forest selectively cut and pruned trees. Site material was provided by Lombardi and landscaping was accomplished by New London County Landscaping. Peter Fusaro of Preferred Builders has provided the certification services for the ENERGY STAR® and NAHB Green programs.

PROJECT PHOTOS: IMAGE 1 of 8 NEXT ▷|◁ PREVIOUS

Appendix D.3.7.8
Publicity: News Articles

Builder: Prototype Home Exceeds Standards

Energy Consumption On Green Home Minimal, Builder Says

POSTED: 5:40 pm EDT May 20, 2009
UPDATED: 9:03 pm EDT May 20, 2009

MONTVILLE, Conn. -- When the foam being installed on a Colonial-style house in Montville is in place, the developer said the energy consumed by the house will be so minimal that it will exceed even the best efficiency standards.

The prototype home at Greenbrier, a 14-lot subdivision, is being wrapped in insulation using the most energy-efficient products available, builder Jim Pepiton said. He said the homes also include factory-made, foam-insulated panels that are being installed on the roofs.

"You notice that there is an air gap, so the asphalt roof will be attached to this three-quarter-inch plywood, and the air will circulate under this," Pepiton said.

The house is the Builders Association of Eastern Connecticut's green showcase home for 2009. The inside of the 2,800-square-foot, three-bedroom home is very open, and the association said residents can check it out for themselves.

"On Saturday mornings, we're going to be running education seminars here for homeowners builders, just to show, 'What does green mean?'" Pepiton said.

Green, he said, means angling the house for a southern exposure for the solar panels on the roof, using a heat pump to keep the house warm and installing triple-glazed windows.

The three-inch Styrofoam on the side of the house also includes an air filtration barrier.

Energy-efficient homes cost more to build, Pepiton said, in the $300,000-plus range.

But he said homeowners will save tens of thousands of dollars in the long run.

For more information, click here.

Related To Story

VIDEO

- Developer: Homes To Exceed Efficiency Standards

BA-0911: Prototype House Evaluations—Ark Ventures, Greenbrier Prototype

Video | Photo

Green housing development in Montville

Updated: Friday, 05 Jun 2009, 6:27 PM EDT
Published : Friday, 05 Jun 2009, 5:12 PM EDT

Tina Detelj

Montville (WTNH) - A new housing development in Montville is going green. From the inside out, it's all about energy efficiency.

The usual sounds of a house under construction can be heard, but developer Jim Pepitone, from Ark Ventures says it isn't any ordinary home and it isn't any ordinary insulation.

"What we're concentrating on today is air sealing the house," Pepitone said.

"It forms that complete air barrier and that air seal," Dan Leonard, from Anchor Insulation, said. "What that does is it cuts down dramatically on the amount of air and moisture that enters the house from the outside."

This home is the first of 14 in an all-green development. The key to its energy efficiency is the thickness of its walls. Instead of 10 inches, the roof is 17 inches thick.

"You're looking at a 2 by 12 and on top of the roof there's five inches of insulation," Pepitone said.

That extra five inches on the outside of the roof is provided by what's called a cool vent. There's a little air pocket and right on top is where the shingles go.

And on top of the shingles there are photovoltaic panels allowing solar power to help heat the home.

This type of efficiency does come at a price. The three story house goes for $439,000. It's cheaper than other green homes but more expensive than most other homes this size. Pepitone says the savings come later.

"I've heard it's as low as $50 to $75 a month for heating bills," Pepitone said.

Still, developers say going green is expensive and buyers aren't demanding it. Pepitone will hold green building classes at a model home in Montville.

"The goal is to change minds with these classes," Pepitone said.

Connecticut Events Calendar

Saturday Retreat on Mindfulness and Self-Care for Women with Cheryl Jones-Reardon
11/7/2009
Holy Family Passionist Retreat Center, 303 Tunxis Rd., West Hartford

Visions of Gingerbread: The Sweetest Architects.
11/7/2009
39 Scofieldtown Road
Stamford, CT. 06903

Indoor Century Ride for the Cure
11/7/2009
141 West Main Street
Clinton, CT

See all »

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Appendix D.3.7.9
Publicity: Websites

BA-0911: Prototype House Evaluations—Ark Ventures, Greenbrier Prototype

Montville subdivision to be 'green' showcase

By Lee Howard

The Day

Published 05/29/2009 12:00 AM Updated 05/29/2009 04:50 PM

Montville - Most new subdivisions take a while before landscaping starts adding color to the barren earth, but The Homes at Greenbrier in Oakdale will be "all green" right from the get-go.

Builder Jim Pepitone's 14-lot subdivision is being built as a sustainable green community, with fireproof fiber cement siding, a precast insulated foundation, a manifold plumbing system and south-facing photovoltaic installation among the highlights. Net-zero energy costs - meaning the amount of energy produced by the subdivision should be at least equal to the amount it expends - will be one of the main goals of The Homes at Greenbrier.

The first of the subdivision's houses, at 6 David Drive, will also be the region's first Green Showcase Home of the Year. "It's a very special property," said Stella Elbaum, a Realtor with Prudential Connecticut Realty. "A huge effort was made to not disturb or disrupt the environment in the entire process."

The Builders Association of Eastern Connecticut and the Chamber of Commerce of Eastern Connecticut will hold a ribbon cutting at the home at 10 a.m. Wednesday, June 3, to show off the early stages of construction. The 2,800-square-foot home, which should be completed by Labor Day, is currently scheduled for public viewing starting Sept. 25, Elbaum said.

Elbaum said the subdivision's homes, which start at $339,900 for the smallest 1,800-square-foot model, will include the latest technology and materials, including dual-flush toilets and triple-glazed windows.

"They're not fancy, but they're nice," she said. "The days of the McMansion are basically over."

Elbaum said the local builders association decided to highlight members involved in green building by focusing on a highly efficient home that has a low impact on the environment. The home is being developed by Ark Ventures and Ark Contractors.

The Homes at Greenbrier, off of Old Colchester Road, is on a 50-acre site that includes a 12-acre nature preserve. For more information, call Elbaum at (860) 572-4722 or e-mail stellaelbaum@prudentialct.com.

l.howard@theday.com

CLICK TO SEE ALL COMMENTS

NorwichBulletin.com explore the possibilities

Hot property: Homes at Greenbrier offers green and enjoyable eco-friendly living

By FRANCESCA KEFALAS
For The Norwich Bulletin
Posted Sep 25, 2009 @ 08:35 AM

Going green can mean different things to different people. For James Pepitone, the developer of the Homes at Greenbrier in Oakdale, going green means starting from the bottom.

Pepitone is building 14 homes on individual two-acre lots to create a sustainable and attainable green community. The first home, 12 David Dr., is near completion and ready to be shown to prospective buyers. Pepitone is offering buyers three levels of green to choose from, all of them more efficient than required to be considered an Energy Star home.

With the Colonial at 12 David Dr., Pepitone has built a home that far exceeds the Energy Star ratings. Using the Home Energy Rating System, a home must score an 85 to be considered Energy Star. The lower the rating, the better the home's efficiency. The Colonial's rating is 40, with each point equaling one percent greater efficiency.

To accomplish this fantastic rating, Pepitone has created an insulated envelope the home sits in. It starts with insulation under the basement floor and around the basement walls. It extends to walls 10-inches thick and a roof 17-inches thick. They are insulated with a highly rated and non-toxic foam insulation.

Heating

The insulation is so effective, the furnace can be significantly smaller than the average home furnace and yet is more than adequate to heat the home. Pepitone has also engineered the home to allow the correct amount of fresh air to enter to ensure healthy air quality.

The home also has an instantaneous gas boiler, which means there is no tank of water that needs to be constantly heated by the furnace to ensure the home has hot water.

All the homes are built to be passive solar. They are oriented to take advantage of the sun's warming rays, and have features such as eyebrow roofs to ensure the summer sun does not overheat the home.

The Colonial has a lovely open floor plan on the first floor. The living room, kitchen and dining room create a wonderful space. It is a perfect space to keep the family together and also to entertain. A gas fireplace will not only add ambiance, it will help heat the home.

The kitchen has wonderful wood cabinets and granite countertops. The cabinets are stained with non-toxic material. All of the appliances are Energy Star.

Off the dining room, sliding doors lead to a deck. There is plenty of room for a table, chairs and grill. Off the deck are a rainwater collection barrel for watering outdoor plants and a compost barrel.

The staircase leading to the upper floors creates a column of air where venting fans allow for passive cooling of the home. Just off the landing to the second floor is an open den area. It is the perfect spot for the family computer or an entertainment area.

Bedrooms

The home's three bedrooms are on the second floor. The master suite is sizeable and has a full bathroom. The walk-in closet is tremendous and is

meant to be both a closet and dressing room.

The two secondary bedrooms share a full bathroom and are generously sized. There is also a large laundry room on the second floor.

The home has a third floor that can easily be finished for additional bedrooms, a home office, playroom or more.

The material in the home is also green. All the paint in the home is free of volatile organic compounds, meaning there is nothing to give off gas and cause problems with indoor air quality.

There are also special touches throughout the home, such as crown moldings, oak flooring and elegant fixtures. Large windows are efficient, yet also add style and character to the home.

Pepitone said he wanted to create green homes that were also enjoyable to live in — he has succeeded.

At a glance

Address: 12 David Dr., Oakdale.
Price: $439,000.
Bedrooms: 3.
Bathrooms: 2.5.
Style: Colonial.
Lot size: 2 acres
Development: Homes in the development start at $339,000 and are offered in a range of styles.
For more information, e-mail Stella Elbaum of Prudential Realty at StellaElbaum@prudentialct.com or call (860) 463-3891.

Appendix D.3.7.10
Builder's Challenge Certificate

U.S. Department of Energy

EnergySmart Home Scale℠

Estimated annual energy usage:
Electric (kWh) 8411

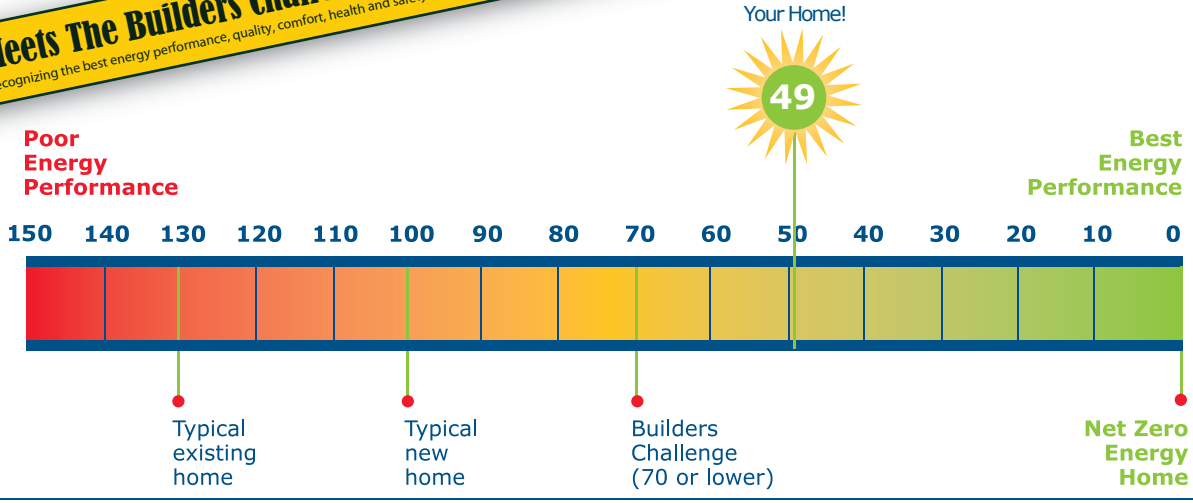
Conditioned floor area (sq. ft.): 2696

12 David Lane, Montville, CT 06353
Rated by **Building Science Corporation**
Rating conducted **September 24th, 2009**

www.buildingamerica.gov/challenge

Meets The Builders Challenge

Recognizing the best energy performance, quality, comfort, health and safety in the market.



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