



The First Optimum Performance Home®

exterior and interior infrastructure part XX

Architectural Illustration By Ronald Devasa

Gary Reber

synopsis

The Uponor® AquaSAFE™ Residential Fire Safety System is an interconnected grid of plumbing fixtures and sprinklers, providing a reliable, non-stagnant system that confirms fresh water is available to the sprinklers each time a cold-water plumbing fixture is used.

The WaterFurnace International, Inc. geexchange system (also commonly referred to as a ground-source heat-pump system or geothermal heat-pump system) consists of three main components—the heat pump, which is the foundation of the system (manufactured by WaterFurnace); a closed-loop vertical “well” system, which is drilled into the Earth on site (Weeks Drilling & Pump Company); and water, which is circulated between the ground loop and the heat pump in high-density polyethylene pipe.

The Apricus Solar Collector or Solar Water Heater is a device that absorbs thermal energy from the sun and converts it into usable heat.

A Navien America NR-240A Condensing 98% Tankless Water Heater is the most efficient on-demand tankless water heater on the market. The Navien utilizes “condensing technology” to achieve a 98 percent efficiency rating.

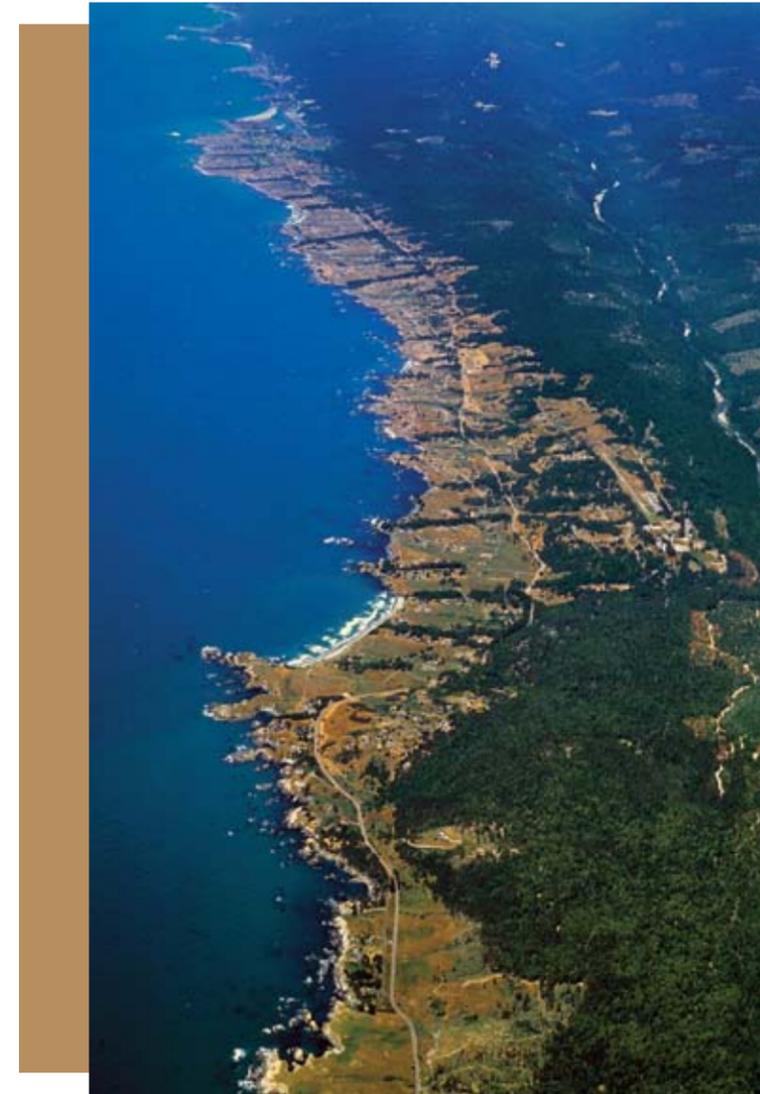
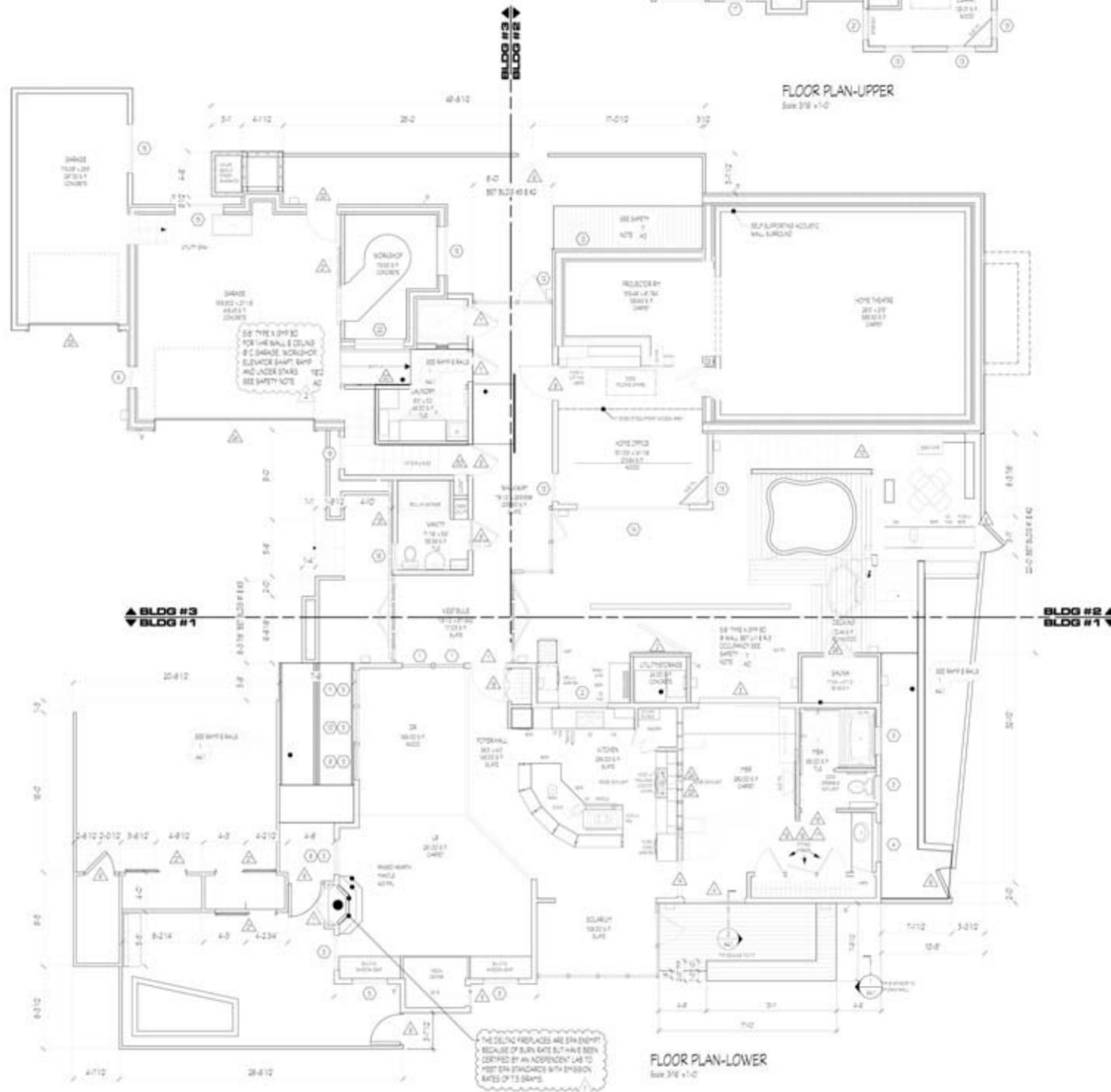
Introduction

This is the twentieth article in the series, documenting the design and construction of the first Optimum Performance Home®. The home has been under construction now for over two years, after more than five years of design and plan development work. Construction financing is being provided by San Francisco-based New Resource Bank, a community bank chartered to fund “green” projects.

The project was selected by the U.S. Green Building Council (USGBC) for inclusion in the national Leadership In Energy & Environmental Design (LEED®) for Homes pilot program, the nation’s most challenging green build certification initiative, and the home is expected to exceed the points required for Platinum certification.

Nichoel Farris, a LEED Accredited Professional with the California USGBC’s designated “provider” organization Davis Energy Group, based in Sacramento, California, visited the construction site in March and following a three-hour-plus inspection determined that the home would exceed the credit requirements for Platinum certification, even without credit for the large 37-unit high-performance premium photovoltaic Day4 Energy® 48MC module 6.66-kW solar PV system, which is designed for installation on the south-facing roof of the dedicated Optimum Performance Home Theatre™ (see Part XII, Issue 12, November/December 2007) and the future wind turbine system, under development. Nichoel was impressed that the home exceeded the Platinum credits even though the home is larger than the typical Platinum-certified home, and at the home,

The First Optimum Performance Home® At The Sea Ranch



The Sea Ranch, Sonoma County, California

due to the high-performance building systems employed, exceeds California building code requirements and California Title 24 standards by 37.3 percent above the minimum.

The home is being built at The Sea Ranch, located in Sonoma County, along the Northern California coastline of the Pacific Ocean, approximately 110 miles north of San Francisco.

To document the day-to-day construction of the home, an iBeam Systems time-lapse construction camera has been up and running since construction started in early 2008. Visit www.ultimatehomedesign.com/oph.php and then click on the "Optimum Performance Home Build Cam" button. Photos are captured and automatically uploaded to iBeam's secure server every 15 minutes from 6:00 a.m. to 6:00 p.m. each day. The images can easily be e-mailed or printed to document job site conditions. To view time-lapse archive images, enter the user name ophsearch and the password ophsearch. These monthly videos are comprised of the daily time-lapse images taken during each month the iBeam System has operated, dating back to April 2008.

Using iBeam's technology and an "always on" GetWireless AirLink Raven X EVDO V4221-VA and AirLink Dual-Band EVDO Antenna, our team is able to view a high-resolution photo archive of the entire project daily, including stunning 1920 x 1080p (progressive) high-definition time-lapse movies each month (see a standard-resolution version at www.ultimatehomedesign.com/oph-photos.php).

Upon completion, the entire construction photo archive will be featured as a 1080p high-definition time-lapse movie and will become part of a high-definition television program and educational documentary that Steve Michelson Productions and I are producing.

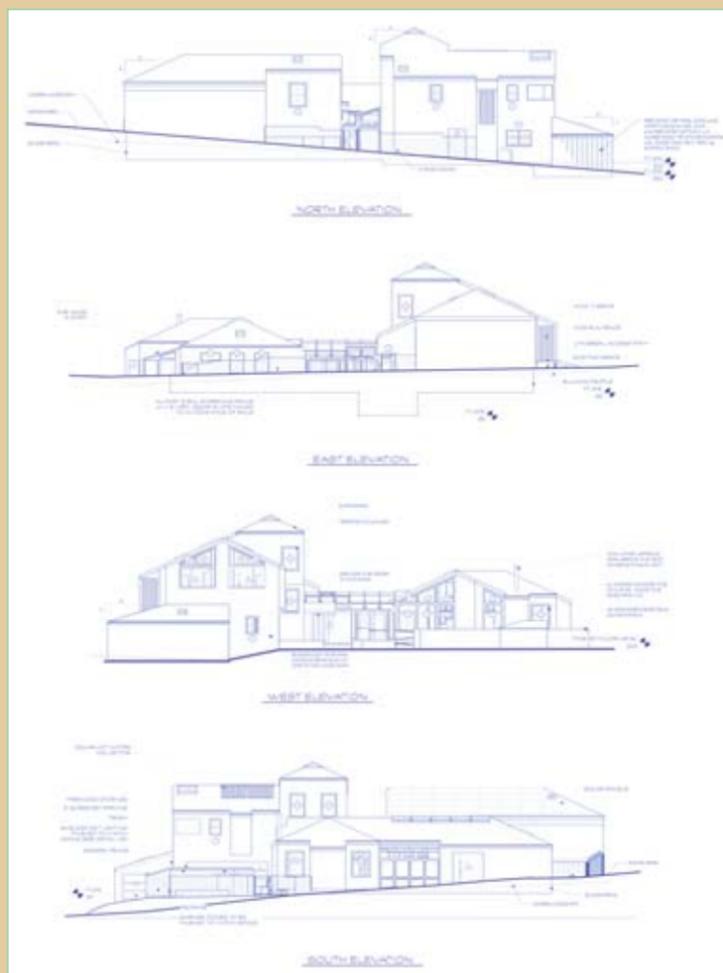
Ultimate Home Design® Concept

The showcase project is exemplary of the "Ultimate Home Design®" concept, which integrates age-friendly, universal design with the best sustainable building practices, while exerting minimal impact on the environment. Universal design is the inclusive, non-discriminatory design of products, buildings, environments, and urban infrastructure; as well as information technologies that are accessible to and useable by (almost) all. With respect to home design, the idea is to design and build homes that have no physical barriers, thus sustaining people of all ages and all capabilities in a functional, comfortable, and aesthetic lifestyle.

A building-science systems approach to home building is the cornerstone of the project, with emphasis on the relationship between the home's components and the envelope it creates. Also paramount is good stewardship—proper regard and respect for the rights of neighboring homeowners and the surrounding natural setting, and resource efficiency. The goal is to optimize occupant health, comfort, and safety; maximize energy efficiency and structural durability; and minimize environmental impact. In addition, the aim is toward providing a nurturing home environment to support independent living and sustainable lifestyles.

Part I of this case study series appeared in Issue 1, January/February 2006. The introductory article covered the

"The science of optimum performance homes concerns itself with building structures that use less energy, are quieter and more comfortable, have fewer problems with material degradation, provide clean air and water, and do less damage to the environment."



The elevations of the Optimum Performance Home at The Sea Ranch

project scope. Thereafter, each issue has contained a part of the continuing series by working through site planning and preparation; Low-Impact Development (LID); further refinements to the site plan and drainage design; The Sea Ranch Design Committee-approved architectural/structural and grading/drainage submittals, with conditions that translated to clarifications on certain building components and material finishes; particular aspects of the home's mechanical plan; structural aspects of foundations, structural walls incorporating Insulating Concrete Forms (ICFs), and Structural Insulated Panels (SIPs), as well as SIP roofing; the acoustical design of the dedicated Optimum Performance Home Theatre™ and rear-projection room; interior design approaches and materials; kitchen, bath, and home fixtures; universal design architecture; fire-risk mitigation; energy generation; and the courtyard experience. "Breaking Ground" was the title of Part XIII, along with "Courtyard Experience." Part XIV and XV, respectively, covered the initial continuing phases of "Site And Foundation Preparation." Part XVI and Part XVII further expanded on the "Site and Foundation Preparation," as did Part XVIII. Part XIX focused on exterior work and the construction of the home's interior infrastructure.

The initial site grading, foundation, and mechanical, plumbing, electrical, and low-voltage infrastructure stages have been completed. This complex and leading-edge under-slab infrastructure work has been documented in the day-to-day time-lapse photography and archived photos on the *Ultimate Home Design* Web site. Also documented is the erection of the Amvic® ICF walls and the Amvic AmDeck® ICF floor to support the guest bedrooms and library/home theatre/surround music room, as well as the ISHN ThermaSAVE SIP walls and roof.

Completion of the home was antici-

pated for April 2009 but due to the mortgage market collapse and the credit crunch, the project was impacted and its completion jeopardized. The project was impacted by the cold realities of the credit freeze. Construction was stopped at the end of January. Fortunately we were able to renegotiate two extensions of our construction loan with New Resource Bank, to enable the completion of the home, now anticipated to be June or early July, 2010. Other unforeseen obstacles and disruptive circumstances related to the SIP fabrication further delayed the project.

Unfortunately, The Sea Ranch Association, which has been extremely difficult to work with during the design and construction stages, continues to fine our project each month due to non-completion within 12 months of the issuance of its permit. The construction delays have resulted due to site and weather conditions and other circumstances not in our control. The Association's Department of Design, Compliance & Environmental Management conducts automatic inspections every 30 days and fines our project as per the Board Violation Policy. The Sea Ranch Association has extended no support for the project. Our experience is true to the song, "It's Not Easy Being Green," with no encouragement or support from governing entities, even though this is an "extreme green" national showcase home that is slated to receive the prestigious Platinum certification under the LEED for Homes program of the U.S. Green Building Council. Then too, the project encountered, once again, severe rain storms in February and March of 2009, which further delayed commencement of construction. Construction resumed in April 2009, but then severe rain storms in January and February 2010, again delayed construction.

It is our intent to produce a high-definition documentary for educational

use by the U.S. Green Building Council, the organization who created the LEED for Homes rating and certification program, and for other "green" chartered organizations. Our presentation will reveal the step-by-step process for creating the first Optimum Performance Home—expected to be one of the highest rated LEED for Homes Platinum projects in the world! Separately, we have produced an HD promo, which was requested by *Planet Green*, a network-owned by the *Discovery Channel*. This promo will be promoted to secure national television distribution of a program on the home, which we have titled, the *Ultimate Home Series*. One can view the promo at www.ultimatehomedesign.com/oph-media.php. We are continuing our digital photography and high-definition video production efforts to document the construction of the home. Hundreds of still digital photos are available for viewing at www.ultimatehomedesign.com/oph-photos.php.

Construction Scheduling

Below is the breakdown of the initial site preparation, grading process, foundation work, engineered suspended slab, the Amvic ICF wall and AmDeck ICF floor construction, WaterFurnace® geothermal vertical fields, the large pond, the EcoRain™ underground water cistern, above slab SIP walls and roofing, courtyard, and interior construction. An outline will be provided in Part XXI for the next stage of construction relating to the interior preparation and finishing.

Pre-Construction Start Meetings Site Work

- Clear Lot Vegetation
- Lay Out House Pad
- Install Curtain Drain Around Pad
- Excavate Optimum Performance Home Theatre, Alcove, and Wine Cellar
- Lay Out Footings
- Install Temporary Electrical Power
- Install iBeam Systems Time-Lapse Pro Construction Camera (See Part XIII)
- Install GetWireless and WildBlue Internet Transmission
- Activate Water Service
- Form Underground ICF Home Theatre, Alcove, and Wine Cellar Walls
- Verify Foundations' Site Placement/Inspection
- Rough Excavation Large Pond and Septic Trench to Designated Leech Field
- Install StormTech Infiltration Chambers (See Parts II, III, and IV)

Foundations

- Dig Initial Stage Foundation Footings and Install French Drain
- Pour First Stage Engineered Controlled Density Fill (CDF) Concrete with Portland Cement and Headwaters Resources Fly Ash (See Part VI)
- Set Forms; Tie Rebar Steel, Hold Downs, and Anchor Bolts
- Pour Final Stage Foundation Footing Concrete with Portland Cement, Headwaters Resources Fly Ash, Kryton's KIM Admixture, Euclid Eucon A+ Type A, and FORTA FERRO Admixture (See Part VI and XV)
- Run Spunstrand Acoustically Treated Air-Conditioning Duct for Home Theatre (See Part V)
- Conduit Trenching for Uponor AquaPEX Plumbing (See Parts V and X)
- Run Armacell Insulated Uponor AquaPEX Hot and Cold Water Tubing (See Part XVIII)
- Run Plumbing Waste
- Run Wardflex Flexible Corrugated Stainless Steel Fuel Gas Tubing (See Part V)
- Run Underground Drain from Wine Cellar to StormTech Infiltrator Chambers Located Across the

Property Frontage

- Install Gravel Around Plumbing
- Run Plumbing Conduit and Supply
- Run Electrical and Low-Voltage Conduit
- Lay Out NuTone Central Vacuum System (See Parts IX and X)
- Run WaterFurnace Geothermal Supply and Return Tubing
- Finalize Underslab Infrastructure
- Install EnergyEdge ICF Frame Building Insulated Form Around Perimeter of Slab (See Part XIV and XV)
- Underslab Inspection
- Place Gravel and Sand Underslab
- Install Cosella-Dörken DELTA-MS UNDERSLAB (See Part XIV)
- Install AMF Corporation R-Control Perform Guard EPS Underslab Insulation (See Part XIV)

- Prepare for In-Floor D-Box™ Technologies Custom Motion Platform In the Home Theatre (See Part VII)
- Install Slab Rebar
- Install Uponor AquaPEX Radiant Floor Tubing (See Part XIV and XV)
- Pour Concrete Slab with Portland Cement, Headwaters Resources Fly Ash, Kryton's KIM Admixture, Euclid Eucon Admixture (See Part VI), and Forta Ferro (See Part XVI)
- Backfill Courtyard and Spa Area
- Install Zurn Flo-Thru Trench Drain (See Part XIV and XV)
- Install NuTone Central Vacuum System (See Part XIV and XV)
- Install Extensive Electrical and Connectivity Conduit
- Pour Concrete Slab with Portland Cement, Headwaters Resources Fly Ash, Kryton's KIM Admixture, Euclid Eucon Admixture (See Part VI), and Forta Ferro (See Part XVI)
- Install AMF Corporation R-Control Perform Guard EPS Around Perimeter of Slab Under EnergyEdge (See Part XIV and XV)
- Waterproof Concrete Stem Walls with Carlisle BARRICOAT-R (See Part XVI)
- Backfill Foundation
- Treat Concrete Slab with Nisus Corporation Bora-Care Termite Barrier Pretreatment (See Part XX)

Exterior

- Construct Amvic ICF Walls (See Part XVI and XVII)
- Construct Amvic AmDeck ICF Floor (See Part XVIII)
- Pour Concrete Into Amvic ICFs and AmDeck (See Part XVIII)
- Waterproof ICF Walls with Carlisle BARRICOAT-R (See Part XVIII)
- Apply Cosella-Dörken DELTA-DRY Ventilated Rainscreen Air Barrier to ICF Walls (See Part XVIII)
- Apply Fiber Cement MaxiPanel and MaxiTrim Cladding to ICF Walls (See Part XIX)
- Construct Simpson Strong-Tie Strong-Wall Shearwalls
- Construct Firewood and Trash Shed
- Install Underground 500-Gallon Propane Tank
- Construct Owens Corning QuietZone Acoustic Wall Framing Studs (See Part XVIII)
- Position Dimension One Amoré Bay Spa in Courtyard (See Part XIX)
- Install Kohler BodySpa Ten-Jet Tower Shower in Courtyard (See Part XIX)
- Dig Five 310-Foot Deep Bore Holes for WaterFurnace Geothermal System (See Part XIX)
- Pressure Test and Install WaterFurnace U-Bend Piping
- Fill Geothermal Bore Holes with Dyna-Crete Bentonite Grout
- Construct ThermaSAVE SIP Walls (See Part XIX)
- Apply Fiber Cement MaxiPanel and MaxiTrim Cladding to SIP Walls (See Part XIX)
- Install Roofing Structural Members

- Construct Optimum Performance Home Theatre Structural Ceiling
- Install ThermaSAVE SIP Walls (See Part XIX)
- Install ThermaSAVE SIP Roofing (See Part XIX)
- Install Cosella-Dörken DELTA-FOXX Class A Fire-Rated Roof Underlayment (See Part XIX)
- Install Batten Plus' BattenUP Corrugated Plastic Roof Battens (See Part XIX)
- Install Trimline Building Products Black Composite Distinction Slate on SIP Roofs (See Part XIX)
- Install Attic Breeze Solar Attic Fan (See Part XIX)
- Install Pella Windows and Doors Along with Fortifiber's FortiFlash Flashing (See Part XIX)
- Install VELUX Skylights (See Part XIX)
- Install Wasco Pinnacle Pyramid Skylight (See Part XIX)
- Seal Exterior with DOW FROTH-PAK Foam Insulation (See Part XIX)
- MoonDance Painting Application of L.M. Scofield's LITHOCHROME Tintura Dark WalnutStain (See Part XIX)
- Install Custom Carriage House Garage Doors (See Part XIX)
- Erect Lindal SunRooms Glass Vestibule, Walkway, and Solarium Structures (See Part XX)
- Install EcoVantage's PerfikDek EcoPrem Wood Decking in Spa Area (See Part XX)
- Install EcoVantage's PerfikDek EcoPrem Wood Decking in Master Bedroom Deck Area (See Part XX)
- Install UNIRAC CLICKSYS mounting systems on South Facing Roofs of Guest Bedrooms and Optimum Performance Home Theatre (See Part XX)
- Install Apricus Solar Collector Water Heater System (See Part XX)
- Install Revere Copper/CopperCraft Copper Gutters and Downspouts (See Part XIX)
- Apply Nisus Corporation's Bora-Care as a Primary Termite Barrier Pretreatment (See Part XIX)
- Install Daltille Continntal Slate ColorBody Porcelain Field Tile Flooring in Courtyard (See Part XIX)

- Install Mapei Opticolor Epoxy Grout (See Part XIX)
- Install UltraGlas Serengeti Low Horizontal Dimensional Glass Backdrop in Courtyard (See Part XX)

Interior

- Construct Interior Walls With Dietrich UltraSTEEL Framing Studs And Drywall Tracks (See Part XIX)
- Install Johnson Hardware Series 2000 Heavy Duty Pocket Door Kits and Barn Door Kits (See Part XX)
- Install PEARL (Permanent Escape And Rescue Ladder) Fire Safety Ladders (See Part XVIII)
- Treat Interior Wood Beams and Framing with No-Burn Fire Retardants (See Part XIX)
- Install RSF Wood-Burning Fireplaces' Delta 2 Fireplace (See Part XX)
- Install Five Dimplex Electric Fireplaces (See Part XX)
- Install Kohler Escalé BubbleMassage Bath in Master Bedroom Suite Bathroom
- Install Sterling/Kohler OC-S-63 Series Rool-In Shower Modules in Guest Vanity Bathroom
- Install Sterling/Kohler Accord Barrier-Free Bathing Module in Second Floor Guest Bathroom
- Install Uponor AquaSAFE Residential Fire Safety System (See Part XIX)
- Install Aquacore Whole-Home Hollow-Fiber Ultrafiltration System (See Part XVIII)
- Install 120-gallon Insulated Solar Thermal Storage Tank
- Install the WaterFurnace International Geothermal Heat-Pump System (See Part XX)
- Install Navien America NR-240A Condensing 98% Tankless Water Heater (See Part XX)
- Install Extensive ENERGY STAR-Qualified Broan SmartSense Ventilation System Throughout Home (See Part XX)
- Install Two Southwest Electric Enterprises QuietCool Whisper Quiet Whole House Fans and Companion EnviroCool Evaporative Cooling Air Systems (See Part XX)
- Complete Rough Plumbing and Rough Electrical
- Install Equi-Tech WQ20 Wall Cabinet Balanced Power System in Rear-Projection Room (See Part XX)

- Install Oregon Shepherd Wool Insulation in Selected Wall Areas (See Part XX)
- Install Acoustiblok Reinforced Dense Noise Isolating & Sound Proofing Membrane in Select Interior Walls and Ceilings (See Part XX)
- Hang Serious Materials QuietRock® Wallboard (See Part XX)
- Mount Owens Corning SelectSound® Black Acoustic Board to the QuietRock Walls in Rear-Projection Room (See Part XX)
- Hang Georgia Pacific (GP) ToughRock Gypsum Wallboard (See Part XX)
- Apply A/V RoomService (AVRS) RoomDamp2 Controlled Viscoelastic Damping (Sound Absorbing) Compound to Optimum Performance Theatre Georgia Pacific (GP) Tough Rock Gypsum Wallboard (See Part XX)
- Install Industrial Acoustics Company (IAC) Noise Rated Doors at Optimum Performance Home Theatre and Rear Projection Room Entrances (See Part XX)
- Pull Monster Cable CAT6, RG6, CL-Rated Loudspeaker, and HDMI Cable in Conduit Throughout Home (See Part XX)
- Staple Phase Change Energy Solutions' BioPCM™ Energy-Saving Thermal Transference Ceiling Mats on Exposed Ceilings Between the Furring Strips Throughout the Home (See Part XX)
- Install AKW Tuff-Form Baarrier-Free Level Threshold Shower Pan (See Part XX)
- Install KraftMaid Honey Spice Cherry Hardwood Cabinetry (See Part XX)
- Apply Frezee Paint EnviroKote Primer (See Part XIX and XX)
- Apply Tobias Stucco Natural Earthen Wall Finish (See Part XIX and XX)

Wine Cellar

- Construct Underground Wine Cellar with Amvic ICFs (See Part XIV)
- Pour Concrete into Amvic ICFs (See Part XIV)
- Construct Concrete Roof to Support Earth Garden (See Part XV)
- Waterproof Wine Cellar Walls with Carlisle Coatings (See Part XV)
- Install Weston Solutions GreenGrid Living Herb Garden

Garages

- Construct West Amvic ICF Garage Wall (See Part XVII)
- Pour Concrete into Amvic ICFs (See Part XVII)
- Construct ThermaSAVE SIP Boat Garage (See Part XVIII)

Propane System

- Install Underground 500-Gallon Propane Tank

Septic System

- Dig Septic Trench, Cut Road, Install Pipes, Backfill Trench, and Repair Road
- Install Roth MultiTank and FRALO Septic Tank Underground (See Part XVIII)
- Equip Septic Tanks with Orenco Risers, Float Assemblies, In-Tank Filtration Systems, Effluent Pumping Systems and Electrical Controls
- Install Sludgehammer Septic Tank Filter
- Dig and Install Septic Leach Field

Geothermal System

- Engage Weeks Drilling & Pump Company Drilling of Five 310-Foot Deep Geoexchange Bore Holes (See Part XIX)
- Install WaterFurnace Geothermal U-Bend Piping Lines (See Part XIX)
- Seal Bore Holes with Dyna-Crete Heat Transfer Sand and Bentonite Clay Grout (See Part XIX)
- Install WaterFurnace Envision Series Heat Pumps (See Part XX)

Large Pond

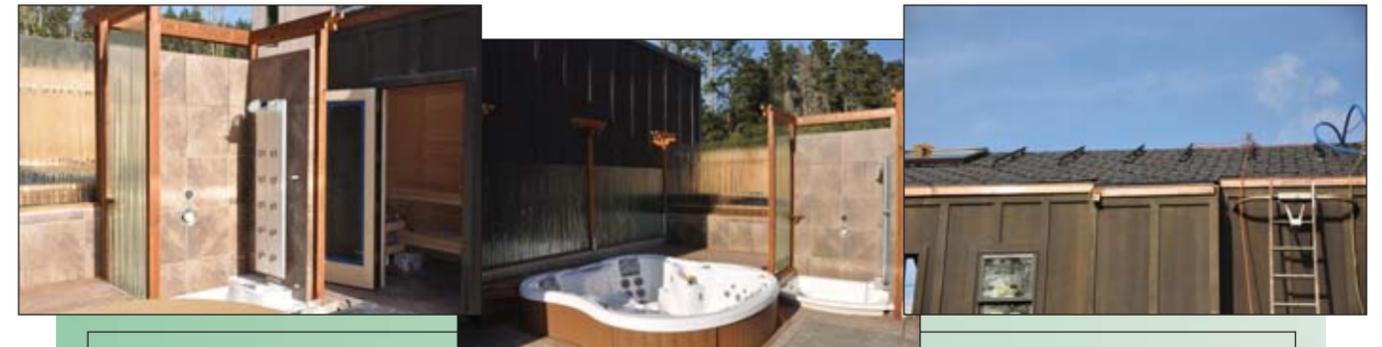
- Complete Final Excavation of Large Pond
- Install CETCO Akwaseal Pond Liner Roll Imagetextile Bentonite Clay Liner
- Install Smart Drain Geotechnical Drains at Large Pond Location
- Install Agri Drain Inline Water Level Control Structure as Part of Large and Small Pond Systems
- Fill Pond with Spring And Rain Water
- Treat Pond with Seepage Control ESS-13 Environmental Soil Sealant

Small Pond

- Complete Final Excavation of Small Pond
- Install CETCO Akwaseal Pond Liner Roll



iBeam Time-lapse Pro Construction Camera Perspective 2010-04-15



Courtyard Kohler® Ten-Jet Tower BodySpa Shower, Finnleo® Sauna, Dimension One® Amoré Bay Spa, Revere Copper/CopperCraft Gutters, Trimline Building Products Distinction™ Slate

Carlisle® Coatings & Waterproofing

- BARRICOAT-R is a waterproofing and vapor barrier membrane designed for vertical surfaces, above or below ground applied to the exterior ICF walls. MiraDRAIN 6200 is a high-performance, high-strength drainage composite consisting of a three-dimensional, high-impact polystyrene core, and a nonwoven filter fabric applied to the wine cellar ICF underground exterior walls.



Owens Corning QuietZone® Acoustical Wall Framing

- Owens Corning QuietZone Acoustic Wall Framing studs are specially engineered with built-in, acoustically resilient, spring-loaded metal clips designed to significantly reduce the sound vibration path and allow the wallboard on the inside of the room to float and isolate sound wave vibrations.



Uponor® AquaSAFE™

- Uponor's AquaSAFE™ Residential Fire Safety System integrates into a home's cold water system. Water circulates each time cold water is used and does not remain stagnant, as with competitive stand-alone fire sprinkler systems.



Imagetextile Bentonite Clay Liner

- Fill Pond with Spring And Rain Water
- Treat Pond with Seepage Control ESS-13 Environmental Soil Sealant

Underground Water Cistern

- Install Stormwater Solutions EcoRain 2,400 Gallon Underground Water Cistern (See Part XVIII)
- Install Firestone Specialty Products EPDM PondGuard Geomembrane Liner Over Water Cistern (See Part XVIII)
- Install Resource Conservation Technologies Sediment Filter and High-Efficiency Pump as Part Of Water Cistern System (See Part XVIII)

John Feeney, who owns Feeney Construction, our previous on-site supervising contractor and lead carpenter, performed the foundation work and the construction of the Amvic ICF walls. John did not return to the project. Roger Stevenson, our electrical contractor, who is also a fully licensed contractor, took over John's role in 2009 as our on-site supervising contractor and lead carpenter. Roger's companies are Sierra Pacific Builders and Stevenson Electric. For a six-month period his brother Dean, an architectural designer and builder, worked on the project and shared duties with Roger. The current crew consists of Alain Bernal, Gabriel Bernal, and Aaron Davila Romero, who all stayed on, plus Richard Howard, a carpenter, Axcel Bernal, and Steve Poulos, a contractor. This crew, plus specialist subcontractors, has been responsible for the remaining construction. Various specialist subcontractors have also contributed to the project, including Travis Swithenbank and his specialist crew at QUALCON on the construction of the Amvic ICF walls and Mic Carmichael of SIPBuilder, an experienced specialist in SIP design and construction, on the modifications and erection of the ISHN ThermaSAVE SIP walls and roofs.

Matthew Jung, owner of 88HVAC, a Geothermal-Radiant-Solar company operating in Marin-San Francisco-Burlingame, California, installed the WaterFurnace geothermal supply and return tubing under the slab, and is working with our plumbers to complete the connections for the elaborate geothermal hot water system.

Sebastopol, California-based Weeks Drilling & Pump Company, under the direction of Chris Thompson, CEO, drilled the five 310-foot-deep geothermal boreholes. This was an arduous task that took two weeks to complete.

Don Bartlett of Bartlett Mechanical Services, along with Matthew Jung, were tasked with installing the WaterFurnace® geothermal system and completing the interface with the Spunstrand® underground acoustically damped air-conditioning duct system for the Optimum Performance Home Theatre. Don also oversaw the installation of Uponor AquaPEX® radiant floor tubing. The Spunstrand system was constructed and installed by John Feeney and Jerry Feeney.

Russell Peffer and William "Willy" Spratt, who both own their own independent plumbing companies, Russell Peffer Plumbing and Spratt Plumbing respectively, have served as our plumbers throughout most of 2009 to the present. They have worked on every aspect of the rough plumbing.

The exterior concrete roof of the wine cellar has yet to be protected with a BARRICOAT-R membrane manufactured by Carlisle Coatings & Waterproofing, Inc. Once completed, MiraDRAIN GR9200 will be applied over the waterproof membrane. This sheeted membrane is designed specifically for green roofs, garden roofs, and large planter applications (in our case an herb garden). Used with the BARRICOAT-R waterproofing, this drainage composite provides adequate water retention for sedums, grasses, and plant life, while providing a channel for excess water to drain.

Construction of the structural interior of the dedicated Optimum Performance Home Theatre has been completed, including the installation of the spring-loaded Owens Corning QuietZone Acoustic Wall Framing studs. (See Part VII for a description of the design of the Optimum Performance

Home Theatre.) The initial electrical work has been completed and has passed Sonoma County inspection.

This Issue

In this issue, the focus continues to be on the various construction elements related to site and above-foundation construction, and interior treatments including the interior connections in the home and installation of the Uponor AquaSAFE™ Residential Fire Safety System.

Unlike competitive standalone fire sprinkler systems, the Uponor AquaSAFE Residential Fire Safety System integrates into a home's cold-water plumbing. It uses the same crosslinked polyethylene Uponor AquaPEX Engel-method (PEX-a) tubing that provides water to the plumbing fixtures, so there is always a ready supply of water to the sprinkler heads. Uponor's PEX-a tubing features the tightest bend radius of all PEX tubing—six times the tubing diameter—which eliminates added connections required in rigid plumbing systems. And unlike metal alternatives, PEX plumbing systems are immune to corrosion, pitting, and mineral buildup. In the Optimum Performance Home, Uponor's AquaPEX tubing is installed in conduit. Uponor's 1/2- and 3/4-inch tubing is encased in red and blue high-density polyethylene (HDPE) corrugated sleeves for added protection and durability in soil and concrete-slab installations, and also allows for removal and replacement, if necessary. The pre-sleeved corrugated AquaPEX is further insulated within the concrete slab with Armacell AP/Armaflex® pipe insulation to retain more heat in hot-water lines and resist condensation on cold-water lines. The expanded closed-cell structure of Armacell AP/Armaflex pipe insulation makes it an efficient insulation for effectively reducing heat loss on the hot-water plumbing and heat gain on the cold-water



Uponor® Pre-Sleeved Corrugated AquaPEX®

- Uponor® 1/2- and 3/4-inch red and blue high-density polyethylene (HDPE) pre-sleeved corrugated AquaPEX® tubing is designed for durability and provides protection for installation in the soil, allowing for easy removal.



Armacell AP/Armaflex® Pipe Insulation

- The expanded closed-cell structure of Armacell AP/Armaflex® pipe insulation makes it an efficient insulation for effectively reducing heat loss on the hot water plumbing and heat gain on the cold water plumbing systems.

plumbing systems. Further, an Uponor PEX plumbing system dampens rushing water noise and eliminates water hammer and singing pipes.

For the AquaSAFE system, a dedicated manifold feeds 1/2-inch AquaPEX tubing directly to a special multi-port fire sprinkler fitting, which connects to the tubing via Uponor's unique ProPEX® fitting system, providing strong, durable connections without the need for torches, glues, solvents or gauges. The four ports on the fitting feed the sprinkler as well as other sprinklers or plumbing fixtures in the system. The result is an interconnected grid of plumbing fixtures and sprinklers, providing a reliable, non-stagnant system that confirms fresh water is available to the sprinklers each time a cold-water plumbing fixture is used. Each sprinkler is either recessed or concealed behind a special plate that falls away when surrounding temperatures reach 135 degrees Fahrenheit. (The sprinkler activates when temperatures reach 150 degrees Fahrenheit.) And because the sprinklers respond to heat, not smoke, the odds of a malfunction are just one in 16 million. While smoke detectors alone increase survival rates by 50 percent, because they warn the home's inhabitants of an impending fire, adding sprinklers increases that to 97 percent. That's because sprinklers can usually extinguish a beginning fire in seconds, even before the fire department arrives and before there's major damage. Fire reports show time and again that property damage is nine times lower in homes equipped with sprinkler systems. And homeowners with a fire safety sprinkler system typically save 10 percent off their yearly insurance premium.

The Uponor AquaPEX tubing in the Uponor AquaSAFE system has withstood the most extensive temperature and pressure tests for over 30 years and features a life expectancy of more than 100 years. In fact, Uponor is so confident in the durability of the AquaPEX tubing and ProPEX fittings, it backs them with a 25-year limited warranty when installed by an Uponor-trained, licensed, professional installer.

In addition, Uponor engineers designed the system for the Optimum Performance Home according to National Fire Protection Association (NFPA) 13D requirements for fire sprinkler systems in one- and two-family homes. Licensed plumbers Russell Peffer and William "Willy" Spratt, with licensed contractor Roger Stevenson, have completed installation of the system to Uponor specifications. The Fire Marshall for the Sonoma County Department of Emergency Service has signed off on the installation.

As stated previously, we had to wait for the ground to dry up enough to support the heavy Weeks Drilling rig that was used to drill the geexchange holes. Weeks Drilling & Pump Company completed the drilling of the bore holes over the course

Weeks Drilling & Pump Company

- Weeks' drilling department can claim over 60 years experience and has completed over 20,000 well projects throughout Northern California and the West Coast, using sophisticated drilling methods to meet the demand for water supply wells, environmental, geothermal bore wells, and irrigation wells.



Dyna-Crete

- Dyna-Crete heat transfer sand and Bentonite clay grout were used to seal geothermal bore holes.



WaterFurnace® Geothermal System

- The efficiency ratings of a geothermal system are up to five times higher than conventional heating and cooling systems. WaterFurnace® leads the industry with its ENERGY STAR®-qualified Envision Series, the first to achieve 500 percent efficiency in heating.



of two weeks. The five bore holes are each 310 feet deep and sealed with 14,000 pounds/280 sacks heat transfer sand and 70 sacks of Bentonite grout with .88 conductivity/2,254 gallons of material in bore holes (305 cubic feet). This special material was provided by Dyna-Crete, based in Valley Springs, California. The special U-bend piping was provided by WaterFurnace and was pressure tested before the pipe was put in the ground and after the holes were backfilled with grout (reference IGSHA Design Guidelines). The bore holes are separated about 15 feet apart. Heat energy is collected and transferred through this earth loop—an underground piping system.

Because the system does not use natural gas or propane, there are no harmful emissions. Geothermal systems reduce our dependence on foreign oil products and use the Earth as a free heat source. In fact, geothermal systems have been recognized by the U.S. Environmental Protection Agency (EPA) and the Department of Energy as the most environmentally friendly heating and cooling technology available today. While outdoor air temperatures fluctuate from season to season, ground temperatures stay consistent all year long. The ground is able to maintain a higher rate of temperature consistency because it absorbs 47 percent of the sun's energy that reaches the Earth's surface. During the heating cycle, a geothermal system regularly circulates water through its ground loop to extract heat. The unit then transfers this heat from the loop through a conventional duct system (heating or air conditioning), hot water for radiant floors, and domestic hot water heating.

For the Optimum Performance Home, a geoechange system manufactured by WaterFurnace International, Inc. has been chosen as the means for heating and air conditioning. The system (also commonly referred to as a ground-source heat-pump system or geothermal heat-pump system) consists of three main components—the heat pump, which is the foundation of the system (manufactured by WaterFurnace); a closed-loop vertical "well" system, which is drilled into the Earth on site (Weeks Drilling & Pump Company); and water, which is circulated between

the ground loop and the heat pump in high-density polyethylene pipe (see previous WaterFurnace reference). The ground-loop portion of the geoechange system uses the constant temperature of the Earth as a heat source instead of natural gas or propane for increasing the efficiency of an electric ground-coupled heat pump. A heat pump can provide both heating and cooling, and it operates on the same type of refrigeration cycles as conventional HVAC equipment. The difference is that the ground-coupled heat pump can take 1 kW of electricity and turn it into 3 or 4 kW of heating energy for the home.

The WaterFurnace Envision Series is designed to dramatically reduce the annual costs for heating, cooling, and hot water in a home by as much as 70 percent per year. No other gas furnace, air conditioner, or heat pump comes close to the Envision's efficiency. The efficiency ratings of a geothermal system are up to five times higher than conventional heating and cooling systems. The EPA states that installing a geothermal system in a typical home is equal to planting an acre of trees or taking two cars off the road in greenhouse gas reduction. The average geothermal system reduces carbon emissions by over 50 tons during its operational life span. In addition, current geothermal installations save more than 14 million barrels of crude oil per year. If one in 12 California homes installed a geothermal system, the energy saved would equal the output of nine new power plants.

WaterFurnace systems use the Earth's ability to store heat energy as a perfect source for high-efficiency heating and cooling. Lisa Meline of Meline Engineering, determined that the constant temperature of the Earth at our bore hole depth is about 62 degrees Fahrenheit. Using advanced technology, WaterFurnace systems tap into that stored energy to provide year-round

home comfort. The environmentally friendly WaterFurnace system saves money and delivers enhanced comfort and safe, quiet operation. WaterFurnace calls it "Smarter From The Ground Up." For more reading, see Lisa Meline's article, "The Mechanical Engineer's Role," in Ultimate Home Design Issue 5, September/October 2006 and Ryan Stauffer's article, "Geothermal Systems Save Homeowners Money And Protect The Environment" in Issue 11, September/October 2007.

WaterFurnace is a leader in the geothermal heat pump industry. WaterFurnace Envision products established a new industry standard for efficiency, performance, reliability, and quiet operation. The ENERGY STAR® Envision Series is the first to achieve a certified GLHP rating of 30 EER (Energy Efficiency Rating) and 500 percent efficiency (5 COP) in AHRI 13256-1. The Envision line is available in seven single-speed sizes (2 to 6 tons) with Copeland Scroll™ compressors. The product is also available in five dual-capacity sizes (2 to 6 tons) with Copeland Scroll UltraTech™ compressors. Scroll compressors are widely regarded throughout the industry as the most durable and efficient compressor technology. The Envision units are equipped with sophisticated yet robust microprocessor controls, compressor monitoring, and today's best digital thermostats. In the Optimum Performance Home we use two single-speed Envision units—NSOH48A101CEL and NSW075A10HCC.

All Envision units utilize ozone-safe R-410A refrigerant, to meet the most stringent EPA requirements. Coated air coils add durability and longer life. ECM blowers are used to increase comfort and efficiency. A sophisticated microprocessor control sequences all components during operation for optimum performance, and provides easy-to-use troubleshooting features with fault lights and on-board diagnostics.

An Emerson Comfort Alert is also included to monitor compressor operation and faults. A hinged door and swing-out control box improves serviceability. Unit configurations include vertical top, bottom, or rear discharge (left or right return) and horizontal units with left or right return, side or end discharge. Heavy-gauge metal cabinets are fully insulated and coated with an attractive and durable metallic silver paint for long-lasting protection. The cabinet's rounded front corners, blue wave styling element and gold nameplates add a touch of elegance to the unit. Envision products are performance-certified to AHRI/ISO 13256-1 standards, ETL listed, and ENERGYSTAR qualified.

The benefits of a WaterFurnace Envision geothermal system are:

- **Energy Efficiency**—WaterFurnace Envision systems are rated number one in energy efficiency because they can deliver an astounding five units of energy for every unit of electrical energy used. Compare that to even the best ordinary system that delivers less than one unit of energy for every unit it consumes. That translates into an efficiency rating of 500 percent, compared to the most efficient gas furnace, which rates only 94 percent.
- **Cost Effective**—Because of the extraordinary efficiency of a WaterFurnace system, any added investment related to installing a geothermal unit is usually more than offset by energy savings. In new homes, most homeowners will experience an immediate positive return on their investment when the system cost is added to the mortgage. In replacement installations, homeowners find that any added investment over the cost of an ordinary system is generally recovered in energy savings within a few years.
- **Comfortable**—Capturing the relatively stable temperature of the Earth to heat and cool a home, WaterFurnace systems provide consistent, comfortable heating and cooling. Temperatures can even be regulated in different areas of the home with an optional zone control system.
- **Reliable**—The WaterFurnace reputation for dependable operation has been earned by using only the highest-quality components, design, and workmanship. Computer run-testing after assembly ensures that WaterFurnace units perform flawlessly at start-up. And in the unlikely event of a malfunction, WaterFurnace units are backed by the best warranties in the industry.
- **Quiet**—WaterFurnace systems don't require noisy outdoor units that can disturb a home's peaceful surroundings or create unsightly additions to a home's appearance.
- **Safe**—Because natural gas, propane, or oil is not required to operate a WaterFurnace unit, there's no combustion, flames, or fumes and no chance of carbon-monoxide poisoning.
- **Flexible**—One compact WaterFurnace unit provides heating, central air conditioning, and supplemental domestic hot water.
- **Clean**—High-efficiency air cleaners found in WaterFurnace systems keep indoor air quality clean, removing dust and pollen for easier breathing.
- **Environmentally Friendly**—The ground absorbs about 47 percent of the sun's energy that reaches the Earth. WaterFurnace systems harness that free, renewable energy and provide an environmentally friendly way to heat and cool a home. Installing a WaterFurnace system is the environmental equivalent of planting 750 trees or removing two cars from the road. And the WaterFurnace system doesn't burn fossil fuels, which means no emissions or harmful greenhouse gases are released into the air.

In the Optimum Performance Home, the WaterFurnace Envision Series geothermal system is used to heat the water used by the Uponor radiant floor system,

which will heat all of the rooms in the home, and in addition, provide air conditioning in the dedicated Optimum Performance Home Theatre and rear projection room through a system of underground Spunstrand filament-wound fiberglass underslab, acoustically damped air-conditioning ducts. This system was selected for the home theatre and projection room because it is expected that more continuous cooling will be required at times to offset the heat created by the projection and audio equipment.

The heat pumps are connected to a single ground-loop system that allows the heat pumps to operate in heating and cooling modes, simultaneously. The WaterFurnace geothermal system also will serve as a supplemental energy source for domestic hot water, in addition to the Apricus Solar® hot water system and the Navien® America CR-240

“condensing 98%” tankless water heater.

The WaterFurnace Envision Series geothermal system final installation is scheduled to be performed by Matt Jung’s team at 88HVAC and by our plumbers Pepper and Spratt. Don Bartlett of Bartlett Mechanical Services worked on the initial infrastructure installation of the WaterFurnace and Uponor radiant floor systems.

The Apricus Solar hot water system is ready to be installed with three AP-20 20-tube solar collector modules mounted to the south facing roof over the guest bedrooms. The dimension of each unit is 77.9 x 58.8 inches, with a height of 6.1 inches,



Weeks Drilling Geothermal Rig, Lindal Vestibule Walkway, Serious Materials QuietRock® Drywall, Oregon Shepherd Wool Insulation, Northeast Views



including a flush roof mounting frame.

The mounting system used is a UNIRAC® ClickSys™, which is engineered for flush roof mounting applications. The anodized bronze aluminum ClickSys has superior aesthetics. The unique I-beam design of ClickSys optimizes strength, eliminates excess material found in other systems, and is cost effective. The ClickSys is also pre-installed, awaiting the installation of the large 37-unit high-performance premium photovoltaic Day4® Energy 48MC module 6.66-kW solar PV system.

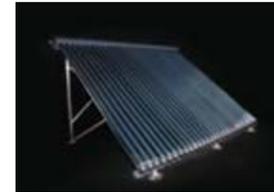
The Apricus Solar Collector or Solar Water Heater is a device that absorbs thermal energy from the sun and converts it into usable heat. The heat is normally absorbed by water, or a freeze-resistant water mix, which can then be used to supplement hot water heating, space heating, and even space cooling via use of an absorption chiller or desiccant cooler technology. In our application, due to the non-freezing coastal climate at The Sea Ranch, water is used to absorb heat.

Apricus Solar units are reliable, efficient, twin-glass evacuated tube designs with integrated



Spunstrand® Filament-Wound Fiberglass Underslab Duct

- Spunstrand® HVAC duct is designed for direct burial applications and is manufactured using the filament-wound method to provide the greatest strength.



Apricus Solar® Evacuated Tube Collectors

- The Apricus Solar® tube system reduces the water-heating portion of a utility bill by as much as 90 percent. Each of the solar collector arrays are made of non-combustible borosilicate impact-resistant twin-glass evacuated glass tubes with a copper super-heat pipe and aluminum heat fin within each tube.



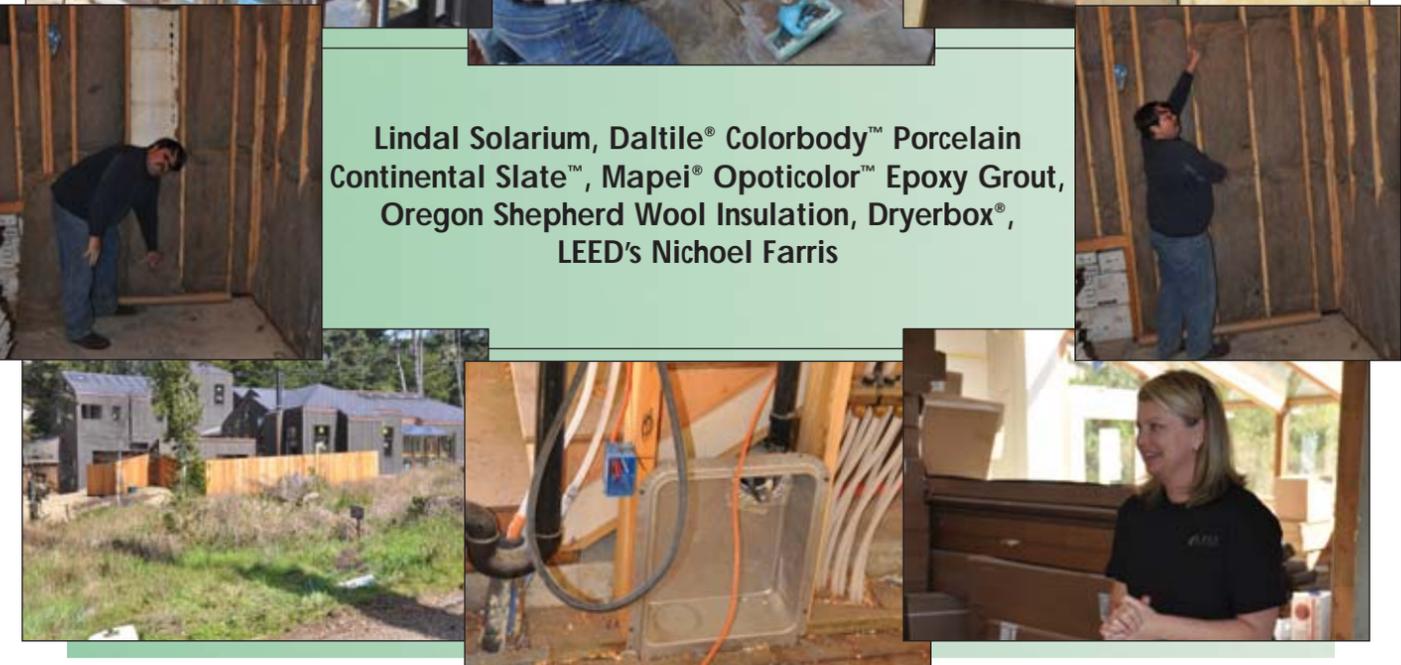
UNIRAC® ClickSys™

- The anodized bronze aluminum UNIRAC® ClickSys™ roof mount system has superior aesthetics, yet the unique I-beam design optimizes strength,

eliminates excess material found in other systems, and is cost effective.



Lindal Solarium, Daltile® Colorbody™ Porcelain Continental Slate™, Mapei® Opoticolor™ Epoxy Grout, Oregon Shepherd Wool Insulation, Dryerbox®, LEED’s Nichoel Farris



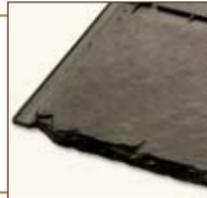
Day4® Energy Solar PV System

- Day4 Energy's 48MC all-black-on-black 180-watt mono crystalline silicon module is both aesthetically attractive and delivers high electrical conductivity, exceptional power density performance, increased electrical contact redundancy, long durability, and cost efficiency.



Trimline Building Products Distinction™ Slate

- Distinction™ Slate has the deep textured appearance of natural slate with deep chiseled edges, creating the most realistic composite slate available.



copper heat pipes and a corrosion-resistant silver brazed copper header for rapid heat transfer. Thick, compacted glass wool surrounds the Apricus solar collector's copper header, providing excellent insulation. The frame is all 439 grade stainless steel with a black aluminum casing. In order to provide maximum corrosion resistance, the Apricus solar collector uses high-purity (99.93 percent) copper piping and silver brazing for the header. The system provides stable solar conversion throughout the day (tubes passively track the sun) and is a perfect solar collector for domestic solar water heater systems.

The operation of the solar collector is very simple.

- Solar Absorption—Solar radiation is absorbed by the evacuated tubes and converted into heat.

- Solar Heat Transfer—Heat pipes conduct the heat from within the solar tube up to the header.

- Solar Energy Storage—Water is circulated through the header, via water pump circulation throughout the day, as long as the temperature of the collector is higher than the stored water temperature. Each time the water circulates through the header the temperature is raised by 9 to 18 degrees Fahrenheit. Throughout the day, the water in the Solar Thermal Storage Tank is gradually heated.

The advantage of solar evacuated tubes is that they insulate the inner tube from heat loss. This means that once heat is absorbed, it is transferred to the water in the manifold and not lost to the outside environment. This is the key difference between solar tubes and flat plate solar collectors: the insulative properties. Combined with the heat transfer efficiency of the heat pipe, the Apricus solar collector can deliver excellent heat output all year round.

How the solar collector looks on the roof was an important consideration for the Optimum Performance Home. The Apricus solar collector is designed to be low profile, sitting close to the surface of the roof. The tubes are black hued and blend in nicely with the black Trimline Building Products Distinction® Slate. The manifold is provided in black (preferred for our application), with either rear (R) or end (E) port models. The rear port manifold allows the plumbing to be hidden behind the solar collector manifold. In addition, by using rear ports, two or more solar collectors may be connected side by side without a gap in between.

Evacuated tubes are the absorber of the solar water heater. They absorb solar energy converting it into heat for use in water heating. There are several types of evacuated tubes in use in the solar industry. Apricus collectors use the most common "twin-glasNRs tube."

This type of tube is chosen for its reliability, performance, and low-manufacturing cost.

Each evacuated tube consists of two glass tubes made from extremely strong borosilicate glass. The outer tube is transparent, allowing light rays to pass through with minimal reflection. The inner tube is coated with a special selective coating (Al-N/Al), which features excellent solar radiation absorption and minimal reflection properties. The top of the two tubes are fused together, and the air contained in the space between the two layers of glass is pumped out while exposing the tube to high temperatures. This "evacuation" of the gasses forms a vacuum, which is an important factor in the performance of the evacuated tubes.

Why a vacuum? As you would know if you have used a glass-lined thermos flask, a vacuum is an excellent insulator. This is important because once the evacuated tube absorbs the radiation from the sun and converts it to heat, the goal is not to lose it! The vacuum helps to achieve this. The insulation properties are so good that while the inside of the tube may be 304 degrees Fahrenheit, the outer tube is cold to touch. This means that evacuated tube water heaters can perform well even in cold weather, when flat plate collectors perform poorly due to heat loss (during high Delta-T conditions).

In order to maintain the vacuum between the two glass layers, a barium getter is used (the same as in CRT television tubes). During manufacture of the evacuated tube this getter is exposed to high temperatures, which causes the bottom of the evacuated tube to be coated with a pure layer of barium. This barium layer actively absorbs any CO, CO₂, N₂, O₂, H₂O, and H₂ out-gassed from the evacuated tube during storage and operation, thus helping to maintain the vacuum. The barium layer also provides a clear visual indicator of the vacuum status. The

silver-colored barium layer will turn white if the vacuum is ever lost. This makes it easy to determine whether or not a tube is in good condition.

Evacuated tubes are aligned in parallel, the angle of mounting depends upon the latitude of your location. In our application the Apricus tubes face south at a 27-degree slope and can passively track heat from the sun all day.

A 120-gallon insulated Solar Thermal Storage Tank is the depository for the water heated by the Apricus Solar hot water system. The system has a comprehensive 10-year limited warranty.

A Navien America NR-240A Condensing 98% Tankless Water Heater is the most efficient on-demand tankless water heater on the market. The Navien utilizes "condensing technology" to achieve a 98 percent efficiency rating. Because Navien's stainless-steel condensing heat exchanger is able to recover the condensation that would otherwise be lost, the small amount of exhaust that is released from Navien water heaters is cool to the touch (about 85 to 130 degrees Fahrenheit), allowing the use of PVC venting materials. The use of PVC offers significant cost savings and simplifies installation. Unfortunately, old-fashioned tank heaters, as well as conventional tankless water heaters, emit harmful Nitrogen (NO_x) and Carbon dioxide(CO₂) directly into the air at a whopping 245 to 450 degrees Fahrenheit! These harmful emissions damage both people and the environment. A Navien condensing water heater decreases no less than 964 pounds of CO₂ per year, compared to a conventional tank-type water heater, and 324 pounds compared to a conventional tankless-type water heater.

Navien's condensing technology uses less propane or gas than conventional water heaters, resulting in less CO₂ emissions. The Eco Pre-mixed



Navien® America Tankless Water Heater

- The Navien® NR-240A Condensing 98% Tankless Water Heater is the most efficient on-demand tankless water heater on the market.



AcoustiBlok®, Tobias Stucco Earthen Plaster, Finnleo® Sauna, Lindal Vestibule Walkway, BioPCM™



Aquacore™ Ultrafiltration System, Uponor® Equipment, Apricus Solar® Storage Tank



Aquacore® Whole-Home Hollow-Fiber Ultrafiltration System



- The Aquacore® point-of-entry ultrafiltration system is capable of producing a steady flow of microbiologically pure water throughout the home.

Sylvan Source Ultra Clean Water System

- Sylvan Source unique multi-stage technology features breakthrough four-stage water processing, consisting of degassing, distillation, demisting, and condensing. The system requires no filters, cartridges, membranes, or chemicals and features a patent-pending, self-cleaning process. The rugged, stainless-steel construction and industry-standard plumbing connections assure long-term durability.



Burner dramatically reduces NOx emission levels, making Navien's emission levels the lowest in the industry. The unit dissolves NOx in condensed water, to neutralize the alkaline sewage and improve water quality.

Navien's built-in hot water recirculation system recirculates hot water that would otherwise be lost, thus, creating a method that lowers the cost of water bills each month. On all Navien Condensing 98% "A" Series models, there are two pre-heating modes in which the unit can operate: Internal Circulation Mode and External Circulation Mode. The desired mode is selected by manually adjusting a three-way valve inside the unit and adjusting the DIP switches on the computer board. Unlike other tankless water heaters, Navien's doesn't require an additional pump or an electric control device, significantly saving on supplementary installation costs.

Navien utilizes dual stainless steel heat exchangers, providing 3.8 to 4.5 times longer life-expectancy and erosion resistance over the copper heat exchangers used in other brands. Navien's stainless steel heat exchangers operate with relatively low water temperatures, minimizing damage from hard water conditions and maintaining high-efficiency levels.

Navien's two microprocessors offer better control and safer operation by continuously cross monitoring each other's performance to assure proper operation at all times. These two microprocessors not only control the burner for ideal combustion but also maintain the steady hot water temperature.

In the Optimum Performance Home, a Navien NR-240A serves as the perfect backup to the Apricus Solar water heating system, should that system not achieve the desired hot water temperature at any given moment. The Navien unit will provide endless hot water in combination with the Apricus Solar collectors and Solar Thermal Storage Tank and WaterFurnace geothermal system. The Navien will only be activated after the water temperature drops below a predetermined set point, say 115-degrees Fahrenheit, then heating ONLY the water actually used, and only for the temperature difference required. The Navien will not only improve the overall efficiency and cost effectiveness of the passive

systems, it will insure an endless and continuous supply of hot water as well, whether the passive systems are providing heat or not. The NR-240A has a heat capacity minimum of 17,000 Btu/hour and a maximum of 199,000 Btu/hour with a thermal efficiency of 98 percent. The DOE Energy Factor is 0.95.

Navien's 15-year warranty is the best in the industry. The parent company, KD Navien, is headquartered in Seoul, Korea.

Our plumbers with Roger Stevenson are scheduled to install the Navien NR-240A on the wall in the courtyard access equipment room. The Navien will share the space with the Solar Thermal Storage Tank, one of the WaterFurnace Envision Series units, and the Uponor control units. The other Envision Series unit was installed in the auxiliary equipment shed/dog house at the back of the rear projection room and interconnected with the Sprunstrand air-conditioning ducts.

In addition to the installation of the Uponor, WaterFurnace, and Navien systems, the plumbers installed the Aquacore® whole-home hollow-fiber ultrafiltration system, a point-of-entry system capable of producing a steady flow of microbiologically pure water throughout the home. This will provide an uninterrupted stream of bottled-quality drinking water to every tap in the home. The unit processes water at the rate of 10 gallons per minute, using a patented multi-bore hollow fiber membrane design with seven capillaries in every fiber. Thousands of membrane strands have billions of .02 micron pores that act as a strainer to filter out particles, turbidity, and pathogens, including bacteria, viruses, and cysts, while allowing water to flow through with virtually no pressure drop. The process does not add chemicals to the household water and improves the performance of other water treatment equipment in the home, such as the Sylvan Source M-600 Ultra Clean Water System (which is scheduled to be installed when the kitchen appliances are installed at the last stage of interior finishing).

Following the construction of the ICF walls and SIP walls and roof, as well as the rough electrical and plumbing, Nisus Corporation's Bora-Care® was applied directly to the cured, finished surface slab and where the walls meet the slab, as a primary termite barrier pretreatment. Bora-Care creates a continuous barrier that termites cannot cross, eliminating their food source.

No-Burn® Original, a Class A fire retardant that meets ASTM E-84 standards, was applied during

the pre-finishing stages of construction on wood beams and other unfinished wood surfaces throughout the Optimum Performance Home. Original provides a transparent, spray-applied zero-VOC (Volatile Organic Compounds) fire retardant coating on interior and exterior porous wood surfaces. Original provides a smooth finish without raising the grain. The non-toxic, non-carcinogenic liquid renders a vast array of materials incapable of burning. No-Burn removes the fuel a fire needs to burn when applied to wood, drywall, fabric, carpet, and furniture. Used on the structural framing components, in combination with the Amvic ICFs and ThermaSAVE SIPs, gives the entire structure a Class A rating, the best possible protection against fire, especially in areas where a high fire hazard exists, such as urban areas with homes in close proximity to each other or in woodland areas, such as The Sea Ranch.



Bora-Care®

- Nisus Corporation's Bora-Care® is a primary termite barrier pretreatment that creates a continuous barrier that termites cannot cross, eliminating their food source.

No-Burn®

- No-Burn® fire retardants and reactants, are a highly advanced line of non-toxic, non-carcinogenic liquids that render a vast array of materials incapable of burning, as well as inhibiting the growth of toxic black mold. No-Burn removes the fuel a fire needs to burn when applied to wood, drywall, fabric, carpet, and furniture.



Oregon Shepherd wool insulation batts have been installed in the Optimum Performance Home Theatre and in other selected wall areas of the home, and covered with two layers of Serious Materials QuietRock® or Georgia Pacific ToughRock® drywall, to provide the finished wall and ceiling surfaces for final interior finishing and acoustical treatment.

Based in Oregon's lush Willamette Valley, Oregon Shepherd engages in extensive sheep farming. Adhering to strict eco-friendly practices from start to finish, Oregon Shepherd works to enhance and expand the traditional markets for wool products, especially making use of the lower-grade and off-color wool, which is typically discarded. The company has successfully



Uponor® Radiant Floor Zone Controls, Equi-Tech 20WQ AC Power System, IAC Acoustical NoiseLock Doors, Monster Cable®, QuietCool™ Ventilation System



Oregon Shepherd

- Oregon Shepherd wool reacts to changes in temperature and atmospheric moisture, achieves impressive R-value thermal performance, absorbs and releases water vapor, contains no permethrin, pyrethroids, or formaldehyde, does not burn, and reduces the level of environmental noise pollution considerably.



Insulation made with natural wool fibers not only achieves impressive R-value thermal performance, but because of wool's thermoregulation properties, wool insulation has the ability to absorb and release water vapor and has been proved through independent laboratory tests to help keep buildings cool in summer and warm in winter.

Oregon Shepherd insulation is made with 100 percent post-industrial natural recycled sheep wool fibers joined together using an advanced resin-bonding process. Oregon Shepherd exhibits the following properties: recyclable, renewable, low-embodied energy, biodegradable, high natural content, no emissions, breathes, no condensation, non-combustible, fire resistant, pest resistant, and safe to handle and install.

Oregon Shepherd insulation contains no permethrin, pyrethroids, or formaldehyde. At the end of a building's life, the

Dietrich UltraSTEEL® Framing

- UltraSTEEL® Framing is a next-generation light-gauge roll-forming technology that significantly increases product performance, including greater load-carrying capacity, higher limiting heights, better acoustical and fire performance, and easier installation.



developed patentable chemical formulations and processes that produce 100 percent natural, non-VOC emitting, fire-resistant and vermin-proof insulation. No other insulation product in the world can make these claims!

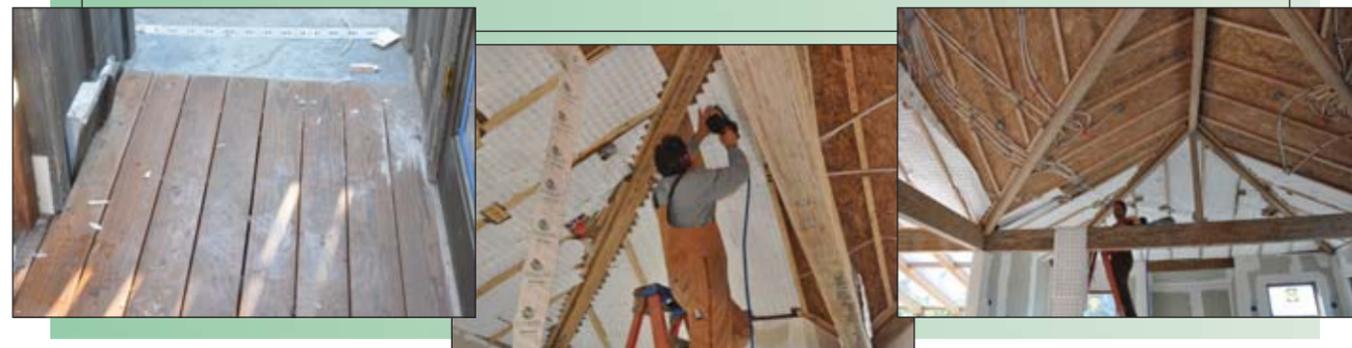
Uniquely, in addition to the traditional batt-style insulation, Oregon Shepherd has developed a natural

wool loose or blown-in insulation, which is terrific for horizontal spaces such as attics, or can be blown into vertical cavities between framing members in walls. It is ideal for the remodel/retrofit project.

Wool, unlike synthetic materials, actually reacts to changes in temperature and atmospheric moisture.



AcustiBlok®, QuietCool® Ventilation System, BioPCM™, Tobias Stucco Earthen Plaster, EcoVantage PerfikDek EcoPrem, Uponor® AquaSAFE™ Fire Sprinkler System



wool can be recycled for other environmentally friendly applications.

Advantageously, untreated wool fiber has higher fire resistance than cellulose and cellular plastic insulations; it does not burn, but rather melts away from an ignition source and extinguishes itself. The loose fill wool insulation is treated with a natural chemical (not petrochemicals) solution to make it even more fire resistant. Oregon Shepherd complies with the appropriate Class A industry standard. And as with other materials and finishes used in the Optimum Performance Home, Oregon Shepherd wool insulation does not emit VOCs and other hazardous compounds, which may contribute to sick building syndrome and other effects, such as allergic sensitization or asthmatic symptoms.

Another unique attribute of wool fiber is what's referred to as its pliable memory. Other loose insulation prod-

ucts, even other natural materials, will settle over time. This results in a lower insulating section. So while the initial 10 inches of fibrous insulation will provide a value of up to R-38, it settles to an actual depth of only 8 to 9 inches, lowering efficiency by up to 20 percent. Wool fibers' unique attributes actually cause it to increase in depth over a several-month period.

Another benefit of this unique quality is that all spaces remain filled, even the tiny cracks and crevices always found in building materials. The expansion of the material in place will affect a total seal. This total seal is almost impossible to overestimate. Most of the heat loss in the walls and ceilings of a home have more to do with the air seal, rather than the insulation.

Acoustically, Oregon Shepherd properties promote the baffling of unwanted exterior noise and can reduce the level of environmental noise

pollution considerably. In sound quality applications, as in the Optimum Performance Home Theatre, natural wool insulation provides desired low-frequency absorption.

Oregon Sheperd 5-1/2-inch thick batting style insulation was used between the Owens Corning QuietZone Acoustic Wall Framing studs in the walls and ceiling during initial construction of the Optimum Performance Home Theatre, and in select other locations in Simpson Strong Walls and between Dietrich UltraSTEEL® Framing studs and drywall tracks. The exposed batts extend to the backside of the QuietZone Acoustic Wall Framing studs with a 1-5/8-inch air gap between the Amvic ICF walls and the backside of the studs and insulation. In the ceiling, the batts are fitted between the studs flush to the ceiling.

Batts are semi-rigid blocks of material manufactured in various widths to



GP ToughRock® Drywall, Monster Cable®, Serious Materials QuietRock® Drywall, EcoVantage PerfikDek EcoPrem Steps & Decking



Johnson Hardware®

- Johnson Hardware® Series 2000 heavy-duty pocket door kits with ball bearing wheels will work with the finished interior doors.



Serious Materials QuietRock®

- QuietRock 530 and 528 patented CPG (ceramic-polymer-Gypsum) composite drywall panels are premium, environmentally friendly wallboards that are pre-primed. QuietRock's unique patented constrained-layer internal damping reduces sound waves and vibration unlike any other construction material on the market today.



Georgia Pacific ToughRock®

- GP's ToughRock Firecode C Type X is a paper-faced gypsum panel designed for interior wall, floor, and ceiling applications.



fit standard framing dimensions, with a thickness that provides the appropriate insulation properties required under agency codes. Typically, this product is manufactured in thicknesses of 3-1/2 and 5-1/2 inches.

As reported in Part XIX, the interior walls are constructed with UL® Classified and UL Fire Rated Dietrich UltraSTEEL® Framing studs and drywall tracks. And as part of the Dietrich UltraSTEEL Framing, we installed six Johnson Hardware® Series 2000 heavy-duty pocket door kits with ball bearing wheels, to work with the finished interior doors.

The interior structure passed Sonoma County Building Department inspection. The interior ICF walls and Dietrich UltraSTEEL Framing studs were covered with Serious Materials QuietRock and Georgia Pacific (GP) ToughRock Gypsum wallboard.

Serious Materials' QuietRock 530 patented CPG (ceramic-polymer-Gypsum) composite 5/8-inch 4- x 8-foot drywall panels were installed in the rear-projection room, the underground alcove of the dedicated Optimum Performance Home Theatre, and on the

two wall sides separating the guest bedrooms.

Additionally, 5/8-inch QuietRock 528 panels in 4- x 8-inch, 4- x 10-inch, and 4- x 12-inch sizes were hung in the laundry room and guest bathrooms, and in the master bedroom wall, which divides the sleeping area from the master bathroom.

QuietRock is a premium, environmentally friendly drywall that is pre-primed. QuietRock's unique patented constrained-layer internal damping reduces sound waves and vibration unlike any other construction material on the market today. A single layer of QuietRock 528 is acoustically equivalent to eight layers of standard drywall. QuietRock is designed and specified by Serious Materials and manufactured by Georgia Pacific (GP). Mold resistance is similar to GP's DensArmour Plus® premium high-performance Gypsum wallboard. Fiberglass mats are featured on both the front and the back for the best in interior protection from moisture currently available.

QuietRock weighs about the same as standard drywall. The panel is UL classified and Type X fire-rated for one

hour. The rated 52 to 74 STC value far exceeds 5/8-inch gypsum, cinder block, and soundboard panels. And it hangs and finishes like standard drywall.

At all electrical and conduit penetrations, QuietSeal® was applied to seal perimeter joints and openings in partitions and to bed electrical outlets and switch boxes set in acoustical panels. The non-hardening, non-skinning one-component butyl sealant is engineered for acoustical isolation in partitions. QuietPutty® moldable soundproofing putty was applied to electrical outlets, HVAC ducts, and conduit penetrations to maintain the performance of the QuietRock and Owens Corning Acoustic Wall Framing acoustically rated walls.

In all non-mold-resistant areas, GP ToughRock Gypsum boards were hung on interior walls. ToughRock is a paper-faced gypsum panel designed for interior wall, floor, and ceiling applications.

In the Optimum Performance Home Theatre, a continuous "barrier" of double-layer, staggered-seam 5/8-inch and 1/2-inch Firecode C ToughRock Type X drywall panels were mounted to the resilient studs structure to attenuate a broad spectrum of sound, including low frequencies and to ensure high-performance fire-rated assembly. Type WS gypsum screws were used. The ToughRock Type X is comprised of an enhanced fire-resistant gypsum core (Type C) encased in 100 percent recycled natural-finish face paper and 100 percent recycled liner paper on the backside. GP ToughRock possesses superior fire-resistance and heat-transmission properties for added safety, and is exceptionally resistant to cracks caused by structural, thermal, or hygro-metric changes.

Georgia Pacific supports sustainable production of gypsum wallboard by using reclaimed gypsum, recycled plant waste, recycled paper, and clean fuels. The company recycles enough wallboard annually to build over 50,000 homes.

As previously stated in Part VII, room acoustics is all about controlling vibrations and the spectrum of frequencies that can influence our listening experience. All materials vibrate sound energy, including gypsum board, and a broad spectrum of frequencies that can radiate energy back into the listening environment. To address this acoustical phenomenon, we applied RoomDamp2™ from A/V RoomService, Ltd. (AVRS), a controlled viscoelastic damping (sound absorbing) compound designed to better control the spectral imbalances typically re-introduced back into the room from the walls and ceiling. Typical wall, floor, and ceiling construction methods resonate like drums, making the room sound slow and muddy by re-radiating energy back into the room later in time. By adding a finish layer with AVRS RoomDamp2 compound in between the 5/8-inch and 1/2-inch ToughRock panels, low-frequency vibrations, resonances, and reflections are minimized. RoomDamp2 was rolled onto the backside of the 1/2-inch panels prior to the panels being screwed to the 5/8-inch panels. The benefits acoustically are:

- Reduces sound transmission to and from other rooms (in our case not applicable due to the massive Amvic ICF exterior wall construction).
- Improves the low-frequency articulation and speed of the room.
- Improves visceral impact—the room is fast and punchy.
- Improves dynamics and resolution. The room quickly quiets, no longer able to mask low-level details.

OSI Green Series low-VOC draft and acoustical caulk, manufactured by Henkel Corporation's North American Consumer Adhesives Business, was extensively applied in the Optimum Performance Home. OSI products help to meet the LEED for Homes ratings guidelines. A 1/8-inch gap was retained where finish corners meet (wall and ceiling) between drywall



A/V RoomService RoomDamp2™

- RoomDamp2™ is a controlled viscoelastic damping (sound absorbing) compound designed to better control the spectral imbalances typically re-introduced back into the room from the walls and ceiling.

panels. This allows the free movement of each independent wall and ceiling assembly. The gaps were filled with a continuous bead of OSI Green Series draft and acoustical caulk, a permanently flexible and non-flammable sound sealant. As well, all other gaps, electrical boxes, penetrations, and ToughRock corners were sealed with OSI Green Series draft and acoustical sealers.

In the rear-projection room adjacent to the home theatre viewing and listening room, a layer of black AcoustiBlok® soundproofing material was mounted to the ceiling, above which is the bonus room designed as a hide-away retreat. AcoustiBlok is a unique 1.1 pound psf UL Classified, high STC reinforced dense noise-isolating material, which is utilized as a structural treatment for reducing sound transmission. It contains no lead or asbestos materials. It is specifically formulated to meet rigid requirements such that is approved by UL for walls, ceilings, and floors.

AcoustiBlok is typically applied as part of layered resilient wall, ceiling, or floor construction. It is usually stapled to wood studs or screwed to metal studs prior to drywall. Each layer of 16-ounce AcoustiBlok reduces sound transmission by as much as 30 dB, depending on the frequencies. It has more sound-deadening effectiveness than some treatments with lead. A typical 2 x 4 Gypsum stud wall is usually 33 to 35 STC. AcoustiBlok installed in the 2 x 4 wall is lab certified at an amazing STC of 52, better than the 12 of poured concrete (STC 51).

Likewise, AcoustiBlok sound blocking material was mounted to the stud walls between the kitchen and the master bedroom, between the two

guest bedrooms, and throughout the elevator shaft prior to the hanging of the Quiet Rock and ToughRock drywall, to prohibit sound transmission between rooms.

AcoustiBlok is waterproof, non-corroding, fire resistant, self extinguishing, and UV and electrical resistant. The material is 100 percent recyclable.

As an additional measure to control sound energy within the rear projection room, Owens Corning SelectSound® Black Acoustic Board was mounted to the interior face of the QuietRock walls and ceiling.

SelectSound Black Acoustic Board is composed of inorganic glass fibers and provides excellent acoustic sound absorption properties to control reverberant sound energy produced within the rear-projection room. At two inches thick, the board will absorb up to 100 percent of the sound, striking its surface across a wide band of relevant frequencies. The rear-projection room is designed to house high-definition video projectors used in a direct-projection rear-screen application.

The IAC noise-rated doors have been installed. Manufactured by Industrial Acoustics Company, Inc., the doors are fully assembled and tested before shipment. Every dedicated performance home theatre must have an entrance door, and the success of the acoustic isolation begins and ends with the door. Both the Optimum Performance Home Theatre and the rear-projection room entrances are fitted with 300-pound plus, 36-inch wide, 3-1/2-inch thick Noise-LockR acoustical doors with an STC 61 rating. These exceptional doors are laboratory-developed and field-proven as they are typically used in high-end recording studios,

AcoustiBlok® Noise Isolating Material

- The AcoustiBlok UL (Underwriters Laboratories) assembly a unique 1.1 pound psf UL Classified, high STC reinforced dense noise isolating material, which is utilized as a structural treatment for reducing sound transmission. AcoustiBlok is the only particular formula that has passed UL's stringent requirements. Therefore, AcoustiBlok has earned a Class A one-hour fire rating.



Owens Corning SelectSound® Black Acoustic Board

- Owens Corning SelectSound Black Acoustic Board is composed of inorganic glass fibers and provides excellent acoustic sound absorption properties to control reverberant sound energy produced within the rear-projection room and equipment/storage alcove.



Industrial Acoustics Corporation (IAC) Doors

- IAC STC-61 Noise-Lock steel door acoustical assemblies feature cam-lift hinges, allowing a barrier-free sill—important for universal design considerations (the door rises as it opens and falls as it closes), magnetic-type triple seals, and magnet sleeve bellows that reach out to provide a continuous seal around the perimeter of the assembly.



Equi=Tech Balanced Power AC System

- Equi=Tech Wall Cabinet Systems are designed to blanket an entire facility with clean and phase-coherent balanced AC power that remains stable regardless of how the circuits are loaded down.



and motion picture and television studios and post-production stages. The two doors are flat black to complement the black, non-reflective flat interior treatment of the theatre. Hinges are cam-lift, allowing a barrier-free sill—important for universal design considerations. The doors rise as they open and fall as they close. Seals are magnetic-type triple seal. The bellows of the magnet sleeve reach out to provide a continuous seal around the perimeter of the assembly. The result is a near vacuum-sealed vault enclosure isolated from the world around.

Our contractor and electrician Roger Stevenson installed the 497-pound Equi=Tech WQ20 Wall Cabinet System on the north wall of the rear-projection room. The 20WQ has a con-

siderable 200-amp output capacity and 20 dedicated 120/60V 20-amp circuits for hard-wiring balanced AC power into the Optimum Performance Home Theatre, rear-projection room, home office, and living room to power a first-surface mirrored rear-projection home theatre system. The 20WQ's input line is 240v, 60 Hz. The system provides the highest-quality components and materials, all of which are factory assembled, such as a large, high-capacity precision toroidal isolation transformer, breakers, GFCIs, 240 Joules surge-protection filters, and EM/RFI line filters, all pre-wired throughout with oxygen-free copper wiring (OFC).

The system's components are housed in a sturdy NEMA 12 steel cabinet and feature a rugged industrial-

duty AC distribution panel board with commercial-grade circuit breakers, transient voltage surge protection, and ground fault circuit interrupters. The 20Q has a two-part black cabinet with a lower section that houses the massive toroidal transformer. The top cabinet measures 36 inches wide, 48 inches tall, and 8 inches deep. The lower cabinet measures 24 inches wide, 30 inches tall, and 12 inches deep.

The transformer is the Equi=Tech proprietary and patented "Q-type," wound with exceptionally low-line impedance copper and includes two Faraday shields for superior isolation from high-frequency RF and current harmonics. This far more efficient type of AC power source keeps current and voltage accurately in phase, regardless of peak current demands. Importantly, "Q" transformers remain acoustically quiet even in locations where there is considerable line distortions and poor power quality and run barely warm at near full capacity. The proprietary winding design drastically reduces high inrush current and also provides for distortion-free video and audio playback performance under the most demanding load conditions. Their performance is exceptional, where power-hungry amplifiers might otherwise choke during high-peak current demands using a conventional power supply. As has been stated in various reviews in *Widescreen Review* (www.widescreenreview.com), Equi=Tech "Q" transformers provide far greater power efficiency during demanding playback material, which translates into smooth current response in amplifier loads. This adds tightness and amazing definition to low-frequency playback and provides exceptional tightness and definition to bass frequencies. The end result is absolute silence when no audio signal is present, and optimum sound and picture performance delivery when the system is engaged.

The entire Optimum Performance Home Theatre infrastructure is designed to deliver non-compromised multichannel discrete audio and high-definition video performance equal or better than the standards attained at professional recording studios and motion picture dubbing and post-production facilities. This infrastructure provides a true state-of-the-art foundation for "the best that it can be" in sound and picture performance.

Early during the construction of the foundation, an extensive network of in-slab electrical conduit was laid out for future room-to-room cable interconnections to handle high-definition video, multichannel uncompressed audio, Internet connectivity, and phones. The early stages of pulling cable to realize these interconnections has been implemented. Roger Stevenson and Paul Hughes of ALD Sound Systems, based in Santa Rosa, California have pulled extensive lengths of Monster Cable® CAT6, RG6, CL-rated loudspeaker, and HDMI cable. Paul is our audio and video installation contractor and is working with me on the implementation of the extensive audio and video and computer interconnectivity throughout the home. Paul and Roger are implementing the original design work performed by Dr. Peter D'Antonio, President of RPG Diffusor systems, Inc.; Norman Varney and Harry Alter, principals in A/V RoomService, Ltd.; Demian Martin, Chief Technical Advisor to Monster Cable; and Bryan Hodges and Tim Johnson of Engineered Environments.

Monster's Dataspeed 500 Cat6 certified cable provides the ultimate in high-speed home networking and control. Roger and Paul pulled two lines of Dataspeed 500 throughout the home. This will be used for computer interconnectivity and phones and other whole-home IP network distribution and control. Two lines of Monster's 75ohm RG6 will be used for RF CATV/broadcast/



CATV/broadcast/satellite HDTV installation hookups, CL-3 Rated Monster XPHP™ Clear Jacket Advanced Speaker Cable, and M2000 HDTV HDMI Cable.

Monster Cable® In-Wall Interconnectivity

- Extensive installation of Monster Cable Dataspeed 500 CAT6 used for computer interconnectivity and phones and other whole-home IP network distribution and control, 75ohm RG6 used for RF

Broan® Ultra Silent Sensing Fans

- The ENERGY STAR®-qualified Broan Ultra Silent Series QTXE fans and fan/lights are the quietest fans in the industry and provide occupant-sensor technology to assure needed ventilation.



Broan® Energy Recovery Ventilator

- The Broan ERV90HC energy recovery ventilator unit features a moisture-resistant enthalpic core and HEPA (High-Efficiency Particulate Air) filtration with antimicrobial protection.



satellite HDTV installation hookups throughout the home. This quad-shielded, high-resolution video cable offers maximum protection against interference and is UL and CSA listed for in-wall installations. Monster's CL-3 Rated Monster XPHP™ Clear Jacket Advanced Speaker Cable is designed to maximize in-wall loudspeaker performance. Finally M2000 HDTV HDMI Cable was installed in the master bedroom wall and in the courtyard equipment wall/door. This cable is HyperSpeed-high speed rated, with bandwidth exceeding 21 Gbps, to support 4Kx2K resolution HDTVs, 3D, advanced projectors, Blu-ray Disc™ players, and game consoles. Monster's M2000 also delivers cutting-edge 3-D movie and game reproduction with full support for dual 1080p video streams. M2000 will be used in the various home theatre systems designed for the home.

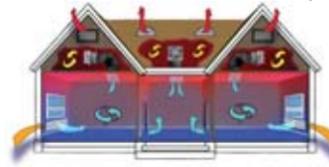
As part of the mechanical system design of the Optimum Performance Home, the extensive Broan SmartSense Ventilation System has been installed. Equipped with ENERGY STAR-qualified Ultra Silent Series QTXE fans and spot

specific QTXE Ultra Silent Sensing fans and fans/lights in the bathrooms, laundry room/garage, the components perform as an energy recovery ventilation (ERV) system to provide fresh air while exhausting stale air and filtering dust and indoor air pollutants. A dedicated Broan ERV90HC energy recovery ventilator unit with moisture-resistant enthalpic core and HEPA filter was installed in the closet area of the master bedroom suite. This silent UL-, CSA- and HVI-certified ERV is the most energy-efficient solution for year-round, continuous fresh-air ventilation.

Broan's energy recovery ventilators remove excess humidity from incoming fresh air. While not a dehumidifier, ERV systems transfer moisture from incoming humid air to the stale indoor air that is being vented to the outside. While humidity is not a pollutant, it can create a range of problems, from health concerns to structural problems. ERV's help to maintain indoor relative humidity between 40 to 60 percent to minimize mold, mildew, and other possible hazards. HEPA (High Efficiency Particulate Air) with antimicrobial pro-

QuietCool™ / EnviroCool™

- Unlike conventional air conditioning, QuietCool™ high-volume fans ventilate homes, removing germs, odors, and indoor pollution and replacing it with healthier outside air. Filtered fresh air is drawn in through the EnviroCool™ high-tech space age media and cools the air by as much as 40 degrees.



RSF Wood-Burning Fireplaces' Delta 2

- The Delta 2 fireplace has a huge firebox, gently curving panoramic glass doors, and beautifully handmade fire-bricks, and utilizes RSF's patented clean burn technology, to achieve exceptionally low emissions.



Carriage House Garage And Barn Doors

- The Carriage House Door Company has crafted thousands of exquisitely designed overhead garage doors for discriminating customers across America. Every door in their Carriage House Collection offers the timeless beauty, authenticity, and quality of doors constructed a century ago, yet they have completely modern functioning.



tection is the most effective filtration available, capturing 99.97 percent of airborne particles including dust, allergens, and pet dander.

The whole-home Broan balanced ventilation system operates automatically and employs patented sensing technology, to regulate the volume of fresh air ventilation and maintain a constant humidity level in the home.

In addition to the Broan SmartSense Ventilation System, Roger Stevenson has installed two QuietCool™ whisper quiet whole house fans and their companion EnviroCool™ evaporative cooling air system manufactured by Southwest Electric Enterprises, Inc. Unlike conventional air conditioning, QuietCool ventilates homes, removing germs, odors, and indoor pollution and replacing it with healthier outside air. These high-volume fans can remove and replace all of the air in the home 15 to 20 times per hour. Each QuietCool unit is connected to an attractive ceiling grill with a patented acoustical insulated flexible duct, thus eliminating all

vibration, rattle, and noise in the home. It is so quiet in operation that it can be installed in a bedroom or sleeping room without a sleeping person being able to hear it. In our application, one two-fan QuietCool QC-4500 unit, called the Quiet Giant, was installed above the kitchen pantry, with exhaust channeled through the equipment room and door out to the courtyard. Like its smaller brother, the QC-1500, the Quiet Giant is an innovative whole-house fan that delivers superior performance, with 4,500 cubic feet per minute of air-flow, while operating almost silently. At the same time, the Quiet Giant will provide additional cooking fume exhaust from the kitchen. A QuietCool QC-1500 was installed above the kitchen nook on the second floor of the guest bedroom quarters with exhaust through the gable end vent. This unit will filter and cool the air on the second floor and in the library/home theatre/surround music room. Another QC-1500 unit was installed in the Optimum Performance

Home and discharges through the attic space above, which positively charges the attic and expels all hot air through the Attic Breeze Solar Attic Fan vent.

EnviroCool is an evaporative cooling air inlet mechanism used in conjunction with QuietCool fans that far more efficiently and effectively cools a home than a conventional air conditioner. The EnviroCool system allows a home to stay cool for about one tenth the cost of traditional air conditioning. By drawing the fresh air in through the EnviroCool high-tech space age media, the incoming filtered air is cooled by as much as 40 degrees and does so whisper quiet. The mechanism can maintain a comfortable 70 to 78 degree Fahrenheit temperature range, even on the hottest summer days, and can condition the interior air to the ideal 45 to 60 percent humidity level, except on very unusual humid days. It does this by bringing in clean, fresh, natural air into the home's interior and ridding it of the undesirable dirty air containing dust, germs, mold, mildew, smoke, odors, and chemicals that have accumulated. It operates automatically on a thermostat, meaning you don't need to turn on switches or open windows.

An evaporative cooling mechanism used with QuietCool fans, EnviroCool can lower the temperature in homes far more efficiently than conventional air conditioners. EnviroCool is one of the most cost-effective "green" additions a homeowner can add. The EnviroCool evaporative cooling unit is located at the front of the home and installed in the exterior wall next to the RSF Wood-Burning Delta 2 fireplace.

Carriage House Garage and Barn Doors completed the crafting of the home's custom garage doors. These exquisitely designed doors are manufactured with solid kiln-dried premium-grade Western red cedar and stained to complement the hue of the exterior L.M. Scofield LITHOCHROME® Tintura™ Stain, a low-VOC, environmentally

friendly stain in Sea Ranch-approved Dark Walnut.

A custom-designed and fitted door to the courtyard-accessed equipment room has been constructed with MaxiPanel fiber cement material to match the home's exterior, and stained in Dark Walnut.

The entire courtyard and solarium floor areas, as well as the walls of the courtyard Kohler® Ten-Jet Body Shower and Dimension One® Amoré Bay Spa, have been finished with Daltile® Continental Slate™ Colorbody™ porcelain field tile and Mapei® Opticolor™ epoxy grout. The courtyard floor area and guest vanity bathroom were covered with 18- x 18-inch Tuscan Blue (CS56) field tile, while the solarium floor area and courtyard spa walls were covered with Moroccan Brown (CS55) field tile.

Porcelain tile, as with ceramic tile, is made up of clay and quartz ferrous sand materials, along with water. Daltile Continental Slate is manufactured in the United States. The special red, brown, or white clay tiles are mined from the earth, shaped, colored, and then fired in kilns to high temperatures (2,192 to 2,462 Fahrenheit). The only difference between porcelain tile and regular ceramic tile is that the clay used in porcelain tile is more highly refined and purified and fired at much higher temperatures. Consequently, porcelain tiles are denser than a standard ceramic tile and the inherent high-hardness rating puts porcelain tile well above other flooring options when it comes to durability. As such, porcelain tiles are more rugged, making them ideal for harsher applications, such as flooring in exterior and interior applications. Also, because of their higher density, porcelain tiles are less likely to absorb moisture (less than 0.5 percent), which makes them more durable and more resistant to staining and dirt, for a cleaner look over time. The low-absorption rate also helps to ensure



Daltile® Continental Slate™

- Daltile's Continental Slate porcelain tiles are denser than a standard ceramic tile, and the inherent high-hardness rating puts porcelain tile well above other flooring options when it comes to durability.



Mapei® Opticolor™ Stain-Free Grout

- Mapei's Opticolor epoxy grout is an optimum-performance, water-cleanable, stain-free grout with chemical and stain resistance.



Lindal SunRooms

- The Lindal solarium and vestibule entrance/walkway combine kiln-dried premium-grade Western red cedar with energy-efficient windows of the highest industry rating for their ability to prevent air and water infiltration under the toughest test conditions.

high air quality in the home, as the floor tile will not absorb chemicals and other unwanted substances.

The matte, unglazed through-body Continental Slate exhibits the appearance of natural slate but the shade variation is less pronounced. Unglazed porcelain tile is homogenous in terms of its through-body coloration. The color goes all the way through from top to bottom, so scratches or dings are less obvious, making them virtually impervious to wear. They also provide better slip-resistance, an important universal design consideration.

The Daltile Continental Slate is one of the most gorgeous floor coverings on the planet and visually enhances the charm and beauty of the Optimum Performance Home's outdoor and interior living spaces. Still remaining is the application of the Moroccan Brown Continental Slate as a pathway through the great room and the flooring for the kitchen.

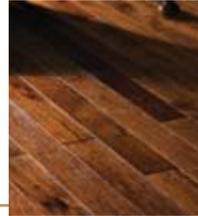
The grout used with the Daltile

Continental Slate was Mapei's Opticolor epoxy grout, an optimum-performance, easy-clean, stain-free grout. Opticolor is an improved, water-cleanable, reactive resin grout with chemical and stain resistance. It is a nonsagging, fast-curing, efflorescence-free grout with no shrinkage. Opticolor provides color uniformity, stain resistance, and durability beyond that of cement grouts. In addition, it is easy to maintain, will clean to the original color, and contains BioBlock™ antimicrobial technology. Opticolor is designed for grouting interior and exterior installations on floors, walls, and countertops. Our color choice blends seamlessly with the Tuscan Blue and Moroccan Brown Daltile Continental Slate for a beautiful, durable exterior and interior hard surface flooring.

Lindal SunRooms, a division of Lindal Cedar Homes, recently completed fabrication of the vestibule, walkway, and solarium structures that were custom designed for the Optimum Performance Home by Lindal designers under the direction of Jim Giroux and our architectural design-

Kährs® Hardwood Floors And Stairs

• Kährs® is one of the oldest manufacturers of hardwood flooring with a 150-year history. In addition to the Kährs flooring Woodloc® system used in selected rooms of the home, the stairs will be Kährs Oak constructed and meet all world formaldehyde emissions regulations.



Pella® Windows And Doors

• Pella® Windows and Doors have been known for quality craftsmanship and innovation. Their EnduraClad® Plus and Seacoast Exterior Paint Finishes ensure superior weather ability and longer-lasting protection against chalking, fading, corroding, and exposure to the sun's UV rays. Pella quality extends to natural wood-framed interiors, which can be painted or stained to match a home's interior décor.



KraftMaid® Cabinetry

• KraftMaid® offers an extensive selection of styles, finishes, storage solutions, and decorative enhancements, including the Sedona cabinet style in cherry wood species.



er/draftsman Ed Rose. Founded in 1945, Lindal Cedar Homes has over 60 years of commitment to being one of the home-building industry's leaders in quality building materials, design, and engineering.

Homeowners who decide to include a Lindal sunroom savor the untold light and luxury it brings to their homes. Lindal sunrooms are built with the same high-quality materials as all Lindal homes.

Like a Lindal Cedar Home, a Lindal sunroom combines kiln-dried, premium-grade Western red cedar with energy-efficient double-pane windows of the highest industry rating for their ability to prevent air and water infiltration under the toughest test conditions. Made with state-of-the-art Low-E argon-filled glass, the windows provide comfort, energy efficiency, and reduce fading of draperies and furniture fabrics. To best capture views, Lindal sunrooms include a hidden connector system, allowing large expanses of glass, uninterrupted by bulky exposed hard-

ware. And the engineering strength of Lindal sunrooms meets or exceeds local building codes.

Engineered for a lifetime of trouble-free living, Lindal sunrooms feature:

- Patented Hidden Connector System—Each Lindal sunroom supports expanses of glass for uninterrupted views. The main framing members of the sunroom are constructed of clear, select, solid kiln-dried Western red cedar. On a post and beam room, the framing members are architectural grade, horizontal, glue-laminated posts and beams.

- The Right Glazing Options—Lindal continually monitors the latest window glazing technologies for advances that stand the test of time. Thermal glass with a special low-E coating provides greater comfort and lower energy costs. A state-of-the-art glazing system bridges the glass panels and provides an air and watertight seal. Lindal dealers are trained to determine the correct

specification and right amount of overhead glass that will work best for a specific situation. Dave Paoli of Masterpiece Homes & Sunrooms, based in Fort Bragg, California, assisted in coordination of the project and gave guidance to our construction team in erecting the structures. Richard Howard spearheaded our team's construction work on the Lindal installation.

The engineering for the vestibule, walkway, and solarium is designed to make the most of the site's exceptional views, light, and climate, while offering year-round comfort and livability. The structures are engineered and designed so that the moisture and condensation will escape and drain to the exterior. The drain design (on both the vertical glass and sloped glass) is critical for moisture and humidity to exit the spaces. Otherwise, within a short time, the wood-framing members will start to rot, and the insulated glass seals will fail. The interior Forest Stewardship Council (FSC)-certified wood will be finished to complement the rich environmentally friendly Kährs® Outback Oak hardwood floors, Pella® Windows and Doors wood treatments, and Armstrong® WoodHaven plank ceilings, as well as the warm matching solid and veneer Cherry hardwood cabinetry throughout the home designed and manufactured by KraftMaid® Cabinetry, Inc., a Masco Company. The exterior of the frame structure consists of anodized aluminum, finished in the same bronze hue as the Pella Windows and Doors exterior EnduraClad Plus aluminum-clad exterior frame finish.

Lindal High Performance vertical glazing carries a lifetime warranty, and the structure and horizontal glazing are warranted for 10 years.

We also installed EcoVantage's EcoPrem™ Wood PerfikDek premium weather resistant decking and railing system. Created from sustainable sourced wood, EcoPrem Wood is thermally modified Yellow Pine with heat

and steam, to create natural lumber that is low maintenance and highly weather resistant. It is natural wood, minus the chemicals, deterioration, and constant maintenance hassle.

Long ago the Vikings learned to overcome the constant maintenance problem by treating the wood surface with fire, which in turn made it more resistant to the weather and thus more durable. The modern version of this ancient process is called EcoPrem. Today a combination of heat and steam is used to modify natural wood. EcoVantage's patented process turns natural wood into a low-maintenance, weather-resistant product.

Europeans have been perfecting the thermally modified wood process over the past century, incorporating steam into the heat process. Incorporating steam allows the wood to be heated to an extremely high temperature, protecting the wood in the process. The steam



EcoPrem™ Wood PerfikDek

• EcoVantage's EcoPrem™ Wood PerfikDek is heat and steam thermally modified premium weather resistant sustainable natural wood, minus the chemicals, deterioration, and constant maintenance hassle.

also aids in altering the makeup of the wood's structure, making it resistant to mold, algae, and decay. This is done without chemicals.

EcoVantage has perfected the heat and steam formula, to produce a superior line of exterior wood products, and has introduced EcoPrem to the U.S. EcoVantage products are produced with #1 grade Southern Yellow Pine at a manufacturing facility in Indiana. Yellow Pine is a renewable resource. New trees grow in the place of the ones cut down to make EcoVantage wood.

EcoVantage shapes and cuts EcoPrem Wood material into PerfikDek

components, which creates one of the most beautiful deck systems available today.

The key features of PerfikDek are:

- Light Weight
- High Strength—Thermal modification strengthens the wood, making it ideal for decks, fences, siding, architectural railing systems, and other exterior projects.
- Sustainable Material—Comprised of renewable Yellow Pine. Since no chemicals are used in the modification process, the wood can be used in gardens, and scraps turned into sawdust and mulch. This unique treated wood is chemical free and completely recyclable.



Phase Change BioPCM™

• BioPCM™ Mats create energy-saving spaces and sources of thermal transference that will take excess heat away from the spaces below, thus essentially absorbing excess heat or releasing stored heat, depending on the fluctuating temperature range in the space.



temperatures, It is engineered around a fundamental property of nature, the natural tendency of materials to absorb heat when they melt (phase change from solid to liquid) and to release heat when they solidify (phase change from liquid to solid). All materials exhibit this behavior, however there are some in particular that go through this phase change at or near room temperature, absorbing and releasing heat in the process. These materials are referred to as phase change materials (PCM). When these phase change materials are placed in quantity into the structure of a home, they absorb heat (air condition) during the day and release heat (heat) at night. This makes the entire energy cycle more energy efficient. Less energy is used to heat and cool a building while BioPCM intelligently captures and release otherwise wasted energy.

BioPCM should not be confused with insulation. Insulation works by increasing the thermal resistance of a building, slowing the flow of heat in and out of the structure. BioPCM works by increasing the thermal mass of a building, therefore, increasing the time it takes for the structure of a building to warm up or cool down. The product is designed to help keep a structure at a prescribed temperature.

BioPCM is not intended to replace insulation. Energy savings from BioPCM is incremental to savings from insulation. This is one reason why the addition of BioPCM to a structure is so effective. The combination of insulation and BioPCM in a building works similar to a resistor and capacitor in an electrical circuit. The resistor (insulation) reduces the energy (heat) flowing through the walls. The capacitor (BioPCM) absorbs the excess energy (heat) that makes it through and releases it when the energy level (temperature) drops below the desired level (thermostat setting).

BioPCM is encapsulated in flame retardant, super-engineered polyfilm,

Armstrong® WoodHaven Ceiling Planks

• WoodHaven Rustic Pine ceiling planks provide an unmistakably wood-look, heavy-grain pine appearance to the ceilings for dramatic impact.



• Zero Toxicity—The EcoPrem process makes EcoVantage products safe. Most pressure-treated woods are produced with the use of toxic chemicals that break down the fasteners that hold projects together. The chemicals in the wood make it harmful to touch, harmful to breathe the air that surrounds it, and harmful to anything that comes in contact with it (skin, clothes, etc.).

• Dimensionally Stable—The low-moisture EcoVantage wood minimizes expansion and contraction, making the wood warp resistant.

• Outdoor Durability—The thermal modification process creates a wood product that is resistant to mildew, rot, and insects.

• Long Term Warranty—EcoVantage wood products carry a 30-year material warranty against rot and decay.

PerfikDek standard decking is available in 1-1/4-inch thick, 5-, 8-3/4-, and 8-1/2-inch wide boards. In our decking application we used the 5-inch wide boards. Custom decks were constructed with PerfikDek around the Dimension One Amoré Bay Spa and Finnleo® Finish sauna and off the master bedroom and abutting the Lindal solarium. The stairs to the herb garden off the courtyard also were constructed with PerfikDek.

Additionally, Gabriel Bernal used PerfikDek's railing system and wood components to form a structural trellis network of posts to support the

UltraGlas decorative sheets of glass that define the spa and shower area in the courtyard. Completely pre-stained at the factory, the end result is naturally aesthetic, adding warmth and beauty to the courtyard.

Phase Change Energy Solutions' BioPCM™ Mats were stapled on the exposed ceilings between the furring strips throughout the home (see BioPCM plan view), between which the Uponor AquaSAFE Residential Fire Safety System AquaPEX runs. BioPCM Mats create energy-saving spaces and sources of thermal transference that will take excess heat away from the spaces below, thus essentially absorbing excess heat or releasing stored heat, depending on the fluctuating temperature range in the space. Since 60 percent of all energy loss is through the ceiling of most homes, this will allow the capture of much of this energy and reintroduction into the structure as it is needed throughout the day, moving from a solid to a liquid, storing and releasing energy as needed by the structure. BioPCM turns the passive ceilings into an active thermal battery with the capacity to lower energy usage in a major way. By incorporating BioPCM into the ceilings, it allows the home to work in a way to reduce its carbon footprint every hour of every day of every year.

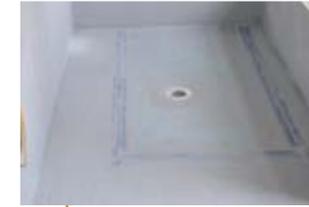
BioPCM's patent-pending material absorbs and releases heat at pre-set

which adds an additional layer of security to any structure. The built-in fire suppressant layer acts as a shield to extinguish most small fires and adds critical extra minutes to allow occupants to escape large more dangerous fires.

Several tests of BioPCM have demonstrated energy savings of up to 30 percent per year. The tests also confirmed that the BioPCM method of encapsulating PCMs did not inhibit their performance. The phase change materials that comprise BioPCM has been tested to 13,000 cycles, which is equivalent to 48 years worth of cycles with no observable breakdown in performance.

Thus, BioPCM increases the comfort, safety and efficiency of homes in several ways:

- reduces indoor temperature fluctuation
- reduces need for heating and cooling



AKW®

• Europe-based AKW is a provider of barrier-free showering, bathroom accessories and kitchen solutions, which enhance people's independence, well-being and quality of life.

- reduces greenhouse gas emissions
- improves safety and reduces fire risk
- shifts energy usage away from peak demand when energy can be most expensive

The pod configuration of the BioPCM Mats allow for easy work around light switches, electrical outlets, and other obstacles. Steve Poulos simply cut away the areas where these items interfered with the installation process. Now that the BioPCM is in place, our team's next task will be to install the Armstrong WoodHaven Rustic Pine Planks as the finishing surface of the interior ceilings.

Both Richard Howard and Steve Poulos are assembling the KraftMaid Cabinetry throughout the home. KraftMaid offers an extensive selection of styles, finishes, storage solutions, and decorative enhancements. In our case, we chose the Sedona cabinet style in cherry wood species.

Cherry is a rich, multi-colored hardwood, often used in fine furniture. In its raw state, cherry has pinkish-brown hues with occasional shades of white, green, pink, or gray. Small gum pockets, streaks, pin knots, and figures are common wood characteristics. Natural and light stains, such as Honey Spice, accent the color variations in the wood.



More Uponor AQUAPEX®, AMVIC® ICF Home Theatre Walls, Structural Engineer Dan Del Carlo, The Stevensons, And Ralph



All cherry wood naturally darkens or “mellows” with age.

A Honey Spice stained finish was selected for the kitchen and kitchen nooks in the home. The contrasting soft-fit cover was stained in Kaffé. The full overlay door style creates a living space with a modern, seamless appearance due to the lack of a cabinet frame showing around each door and drawer front. Some of the upper cabinets feature textured glass doors and decorative light treatment to create contrast, which increases drama and functionality within the space.

Hardware was selected for simplicity and universal design friendliness. The hardware finish is nickel.

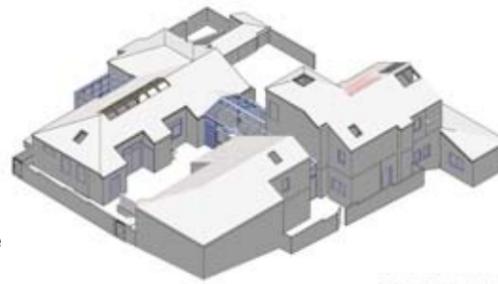
A basic, simple decorative molding was added to make a dramatic difference to the look of the cabinetry.

Harmony storage solutions were also added to provide functional, yet attractive, organization to the drawers.

All throughout the design process, consideration was given to universal design features such as offered with KraftMaid’s Passport Series. One particular feature is the lower wall-oven and warmer drawer cabinet design. Overall, the kitchen design provides innovative solutions that improve usability, convenience, efficiency, and maneuverability, while providing fine design features. The Passport Series is certified for universal design by the Institute for Technology Development.

Some of the quality aspects of KraftMaid Cabinetry include such standard features as sturdy 3/4-inch thick, full-depth adjustable shelves for maximum storage capacity. KraftMaid uses I-beam construction on all base cabinets, which improves durability and ensures level installation. Face frames have a rounded edge to duplicate the appearance of fine furniture detailing and keep hands and wrists safe from scrapes. Special PermaSet Bumpers are made from a pliable material that is securely held in place to cushion doors

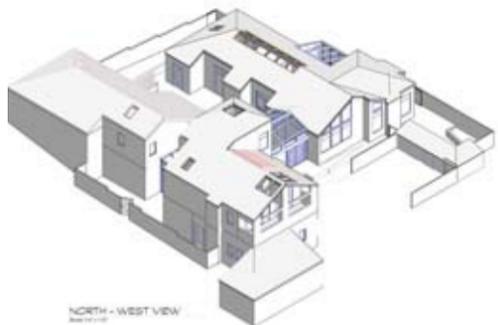
and drawers for a quiet close. Carefully concealed hinges are adjustable up to six ways, for optimum door alignment. Standard on every cabinet is a full-extension, self-closing drawer buffer



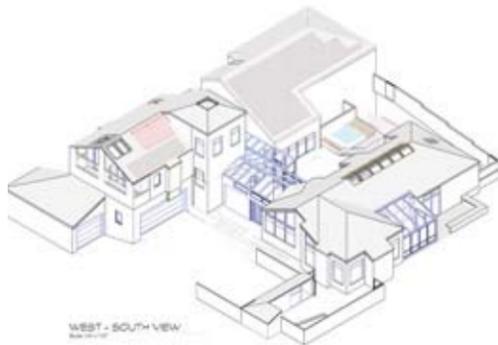
EAST-NORTH VIEW



SOUTH-EAST VIEW



NORTH-WEST VIEW



WEST-SOUTH VIEW

Four Perspective Views Of The Optimum Performance Home At The Sea Ranch

system, which extends past the face frame, providing easy access to kitchen tools. The mechanism closes drawers quietly every time. And KraftMaid’s standard 3/4-inch thick, solid wood drawer boxes feature dovetail construction, to ensure superior strength and durability. The greater clearance between the drawer box and cabinet frame enables storage of larger items.

A lasting benefit inherent in KraftMaid quality craftsmanship is the Limited Lifetime Warranty. J.D. Power and Associates ranked KraftMaid Cabinetry “Highest in Customer Satisfaction with Cabinets” in their 2009 Cabinet Satisfaction Study.

We’ll return to KraftMaid in Part XXI when the entire cabinet installation is complete.

Alain Bernal has installed the AKW® Tuff-Form barrier-free level threshold shower pan in the bathing area of the master bathroom. This ADA-approved pre-formed floor is designed to create a wet room floor shower area with a built-in pitch to drain. AKW is a leading European provider of barrier-free showering, bathroom accessories, and kitchen solutions, which enhance people’s independence, well-being, and quality of life, especially for persons with reduced mobility who want to achieve independent living. We will return to coverage of other AKW accessibility products in Part XXI, including the adjustable dual his and her stainless steel framed wide wooden slatted shower seats and the reinforced aluminum tubular core fluted surface grab bars to be installed in the master bedroom bathroom.

Alain and Gabriel Bernal installed the custom-crafted UltraGlas in the courtyard. Distinctive three-dimensional characteristics provide a unique lens, through which (or off of which) natural and artificial light comes to life, transforming an environment like never before. UltraGlas offers a comprehen-

sive selection of standard textures and designs that naturally express the full range of organic, graphic, traditional, modern, and contemporary styles. In the courtyard application we chose UltraGlas’ Serengeti, a low, horizontal dimensional grass pattern that perfectly complements the look of wild grasses at The Sea Ranch. The 3/8-inch thick finish is clear glass with a slight green hue, which further complements the herb garden above the wine cellar and behind the courtyard spa area. UltraGlas will also be installed between the toilet and Kohler BubbleMessage® bath in the master bathroom and as part of the kitchen island eating counter.

The ABBAKA custom satin stainless steel kitchen island hood was installed by Alain Bernal and ABBAKA’s Frank Paone. This is a custom-designed elongated hood, which houses a KitchenAid® Architect Series 48-inch wide hood liner with internal blower

motor and 1,200 CFM exhaust flow capacity (KHLU182MSS). The hood liner features halogen lighting and hidden variable exhaust fan speed controls. The combination is striking, especially positioned over the professional Vulcan 36RRG low-profile, heavy-duty propane gas griddle, which is a focal point for exhibition cooking.

As stated in Part XIX, Frazee Paint®’s EnviroKote™ Primer will be applied throughout the home directly to new drywall and smooth fiber cement interior surfaces, providing a solid, bright white surface for the application of Frazee’s EnviroKote Flat paint and Tobias Stucco natural earthen plaster. Frazee antimicrobial primers and paints are low-odor, zero-VOC formulations that eliminate the aromatic solvents, heavy metals, and formaldehyde preservatives found in the typical paint or sealer. The result is a non-polluting coating that also acts as a sealer to help

reduce off-gassing from the surface below. Tobias Stucco is also a mold- and mildew-resistant and zero-VOC formulation.

The next installment in this series of case-study articles will cover the interior finishing of the home and continue to cover the actual work being done, to accomplish the tasks described, as well as the installation of UltraGlas decorative glass treatments in the master bedroom bathroom and island kitchen and Armstrong WoodHaven ceiling planks; the application of Frazee’s Green Seal Certified EnviroKote interior, low odor, zero-VOC architectural primer and paints and GreenSpec® listed Tobias Stucco non-VOC and mold-resistant trowelled on interior wall finish earthen plaster; DalTile Continental Slate flooring; Kährs ECO Core Outback Oak flooring and stairs; DURA-SON acoustical wood floor underlayment; Boddingtons BodPave® 85 porous paving grids and porous



Wood & Trash Shed Barn Doors, West Views, Living Room Window Seats & Rear Projection Enclosure, UltraGlas®, KraftMaid® Cabinetry & ABBAKA Kitchen Hood



paving surfaces; STIRA wooden folding loft ladder; Planika Fire Expresione fire-place; and more finishing coverage.

In the meantime, photos and videos will be posted on the *Ultimate Home Design* Web site (www.ultimatehomedesign.com/oph.php) depicting progress in the construction of the first Optimum Performance Home.

Design Concept

As previously noted in this series, the home design integrates all of the concepts advocated in *Ultimate Home Design*. The goal is to demonstrate how modern building products and methods can make life safer, more comfortable, and more enjoyable. The science of optimum performance homes concerns itself with building structures that use less energy, are quieter and more comfortable, have fewer problems with material degradation,

provide clean air and water, and do less damage to the environment. As an integrated and holistic design, the house will serve as a durable residence that allows its occupants to age in place. The exceptionally solid structure should last decades, if not centuries, with minimal maintenance.

The high-performance building systems employed are designed to exceed California building code requirements and California Title 24 standards (nearly 38 percent above the minimum) and resist natural disasters



more effectively than a code-minimum home, even with the new California code requirements that require use of non-combustible or fire ignition-resistant building materials. Constructed with stronger building materials and superior techniques, the home will be safer, allowing homeowners greater peace of mind. The Optimum Performance Home qualifies for the Fortified...For Safer Living® program of the Institute for Business & Home Safety (www.ibhs.org/business_protection). This program specifies construction, design, and landscaping guidelines to increase a new home's resistance to natural disaster.

In addition, the home will meet the guidelines and qualifications for the U.S. Department of Environmental Protection's ENERGY STAR, the EPA's (Environmental Protection Agency) WaterSense™, and the American Lung Association® Health House® programs.

KraftMaid® Cabinetry & ABBAKA Kitchen Hood, AKW® Tuff-Form Barrier-Free Shower Pan, KitchenAid® Hood Liner, Broan® ERV, Carriage House Garage Doors



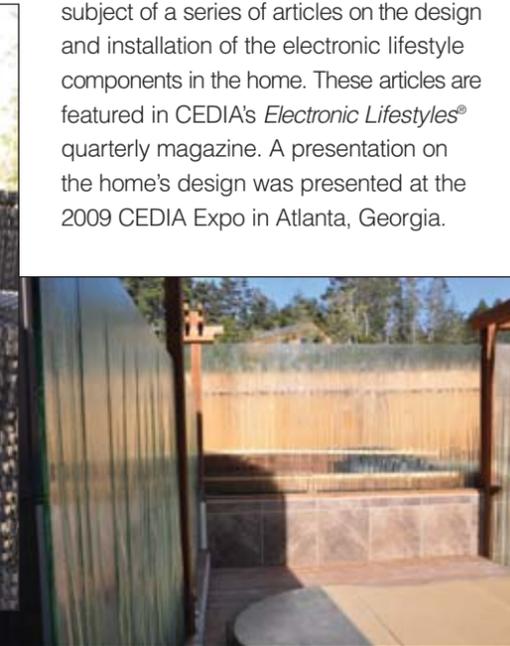
It also will meet the requirements of the National Association of Home Builders' (NAHB) National Green Building Standard, the Sustainable Buildings Industry Council (SBIC) Green Building Guidelines, and the "Green Points" program. Sonoma County and The Sea Ranch Association are now considering this program for adoption.

Furthermore, the home's design was the subject of a case study analysis

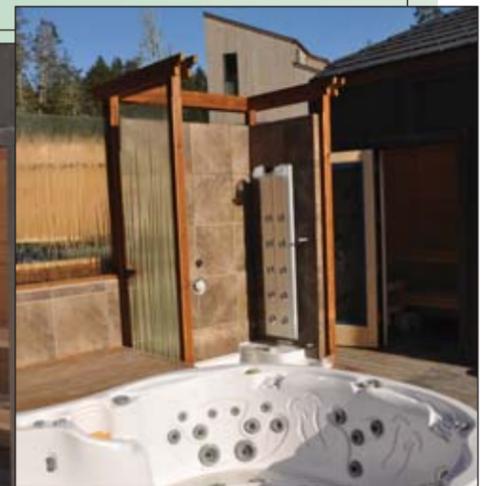
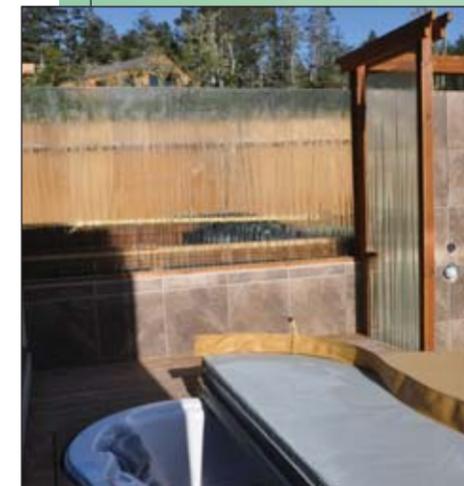
presentation before the Custom Residential Architects Network (CRAN), Full Spectrum Practice Convention of the American Institute of Architects on October 20, 2007 in Chicago, Illinois.

The home is also a case study of the California Energy Commission in terms of energy-efficiency applications and an advanced water-saving plumbing system.

Finally, the home is a national showcase for the Custom Electronic Design & Installation Association (CEDIA), and is the subject of a series of articles on the design and installation of the electronic lifestyle components in the home. These articles are featured in CEDIA's *Electronic Lifestyles*® quarterly magazine. A presentation on the home's design was presented at the 2009 CEDIA Expo in Atlanta, Georgia.



Boddingtons BodPave® 85 Porus Paving Grids, UltraGlas® Serengeti Glass Backdrop Couttyard, Armstrong® WoodHaven Ceiling Planks, Kährs® Outback Oak Flooring, Dimension One® Amoré Bay Spa, Finnleo® Sauna & Kohler® Ten-Jet BodySpa Shower



of Highway 1 along a uniquely beautiful rugged coastline, ending at the northern tip of Sonoma County and the south bank of the Gualala River.

The Sea Ranch is widely regarded as a unique and remarkable residential development. During the 1960s and 1970s, The Sea Ranch was at the forefront of environmentally responsible development. It was conceived and designed by architects and landscape architects who wanted to provide a harmonious mixture of custom homes and pristine natural Northern California landscape in oceanfront, meadow, and forest environments. In fact, The Sea Ranch concept and its architecture are recognized in schools of architecture around the world, and it is frequently used for case studies in environmental and architectural design. The first condominium complex to be built on the southern coastal bluffs of The Sea Ranch is now a registered national architectural site.

Single-family development occupies approximately 2,500 acres, without borderline fences or other visible delimitation of property lines. The remaining acres are permanent greenscape commons with 45 miles of nature trails for walkers, bicyclists, and equestrians. Each home is custom designed by an architect/architectural designer following site-specific design guidelines and is situated off a private road network without curbs, sidewalks, or streetlights. The Sea Ranch is a very unique residential development woven into a tapestry of buildings and nature and committed to environmental preservation. The development includes 2,288 lots for single-family custom homes, with 508 remaining to be developed (1,773 already developed and 7 under construction).

The Sea Ranch is managed by The Sea Ranch Association, a Common Interest Development (CID) with an elected volunteer Board of Directors, and supported by numerous volunteer committees. All development on The

Sea Ranch is subject to design review and the approval of a Board-appointed autonomous Design Committee. The Design Committee is presently comprised of architects and landscape architects, though, it does not include anyone with experience in vegetation management or “green” sustainable building design. A legal set of Covenants, Conditions, and Restrictions (CC&Rs) govern the development and are designed to protect The Sea Ranch concept.

The Home

The Sea Ranch Design Committee imposes upon designers architectural building blocks derived from the original rural structures found on the northern California coast. Designers are expected to apply their creativity to render various arrangements and deviations to arrive at a custom solution that specifically responds to the site. Successful proposals submitted to the Design Committee address the issues of passive solar positioning, wind, glazing (window) layout, privacy between neighbors, vegetation protection, view preservation, topography and grade changes, roof slopes, appropriate exterior materials and finishes, and other exterior design considerations—all within the building and site design.

A focus of the Optimum Performance Home’s design is to stand as a showcase for the “green” movement and demonstrate means of reducing a home’s impact on the planet through the use of Low-Impact Development and environmentally responsible and sustainable building materials. It is hoped that the home will become a case study for a “Green Points Program” suited to the scale of The Sea Ranch.

The home’s 3,272-square-foot conditioned living space (4,441-square-foot total building “footprint,” including garages, covered walkways, courtyard, and decks) is arranged in a three-building compound using a well-sealed, well-insulated, super-tight building envelope

that reduces temperature fluctuations and enhances overall energy efficiency. This arrangement provides for an alcove courtyard protected from the prevailing northwest wind. The courtyard is only open to the east, and then partially.

The home is designed with differing spatial experiences and destinations throughout, to encourage exploration. The home will display innovative interior design and be furnished in a contemporary Frank Lloyd Wright style appropriate to its dimensions. The home design connects the indoors and the outdoors with glass covered walkways, a courtyard, decks, herb garden and a vegetable garden to expand livable space, without requiring heating or air conditioning. The home is designed in accordance with biophilic design principles, with abundant and excellent use of natural light and natural indigenous landscaping planned. (For an in-depth analysis of the biophilic attributes of the home, please read “Biophilic Design,” “Biophilic Design Attributes,” and “The Interior Design Process, Part I: Synthesizing Sustainability, Universal Design, And Technology” authored by Julie Stewart-Pollack in Issue 3 (May/June 2006), Issue 4 (July/August 2006), and Issue 10 (July/August 2007), respectively.)

The main-floor living area is designed to accommodate the capabilities of all occupants without any challenging physical barriers, even for the elderly and disabled. The home design features a ground-level open plan for the living room, dining room, master bedroom suite, and spacious kitchen with solarium, exhibition cooktops, and home-management system.

The second building in the compound is designed to accommodate a large dedicated state-of-the-art Optimum Performance Home Theatre (otherwise known as the Reference Holosonic® Spherical Surround™ Home Theatre Laboratory) with integrated rear-screen projection room, front-projection, and a

home office. This performance theatre is designed as a “black-out” environment with non-reflective black walls and ceiling and controlled lighting to provide maximum picture contrast and dimensionality, along with a 7.1-channel full-frequency spherical surround loudspeaker system capable of extraordinary dynamic range.

The third building will include a two-car plus boat garage, workshop, main-level guest vanity bathroom, and laundry room. The second level of this building will have two guest bedrooms, a bathroom, and a dedicated library/home theatre/surround music room distinguished by a high-tower feature. To insure universal access to this floor, the design provides for an energy-efficient residential elevator.

The entrance and walkways that connect the three buildings and the solarium are enclosed with double-pane insulated- and solar-gain-reduced-tempered glass. There will be a seating area at the vestibule entrance to the home. The main entrance vestibule will serve as an oversized mudroom. The driveway, area around the garage, guest parking, and entrance to the home—as well as all paths around the home—are designed in accordance with The Sea Ranch guidelines, governing exterior hard-surfaced paths. All such surfaces are pervious to virtually eliminate water runoff. The surface will be packed with permeable surface material, to enhance the natural appearance of the home’s setting. There also is a dedicated equipment/utility room off the courtyard, which accommodates the Uponor and WaterFurnace radiant-heating apparatus, Apricus Solar hot water storage tank, Navien’s 98 percent condensing on-demand propane-fired tankless water heater, and other equipment. A backup Kohler generator will be housed within a separate weather-resistant structure located off the north wall of the two-car garage and guest bedroom. An upper level of this struc-

ture (when implemented) is designed to optimize the northwest wind performance of a future wind turbine system, under development.

Along with the wind turbine system, a large 37-unit high-performance premium photovoltaic Day4 Energy 48MC module 6.66-kW solar PV system will be installed on the south-facing roof of the dedicated Optimum Performance Home Theatre (see Part XII, Issue 12, November/December 2007). The wind turbine and Day4 Energy systems’ electricity will be supplied to the Pacific Gas & Electric power grid.

The home site is nestled on an almost-acre parcel at the edge of a forested area of the southern section overlooking the Pacific Ocean, offering distant water views. The orientation of the home on the site is designed to take advantage of natural lighting and passive solar heating and cooling. Good site and land planning results in minimal land disturbance and preservation of natural features and environments.

Landscaping will consist of The Sea Ranch-approved indigenous vegetation, with low-water requirements and unique water conservation features, including two ponds and a stream supported by rainwater catchment and captured runoff. Site grading has been specifically planned to enhance the project’s placement in the watershed, and the design incorporates the principles of Low-Impact Development to minimize runoff from impervious surfaces and mimic the natural hydrology in overall effect. The resultant water harvesting will then minimize the use of irrigation, and the increased infiltration and retention will passively support the native landscape. Additionally, a gray water system will be used for undersurface plant irrigation.

Next

This continuing series of articles will focus on the design elements, as they pertain to each stage of construction

as the project progresses, and will include coverage of the technologies and building systems and the materials used and applied to construct the first Optimum Performance Home. **UHD**

The Author

Gary Reber is the President of Ultimate Home Design, Inc. and the founding Editor-In-Chief and Publisher of *Ultimate Home Design*®, The Green Build And Universal Design Resource™. He is also President of WSR Publishing, Inc. which publishes *Widescreen Review*®, The Essential Home Theatre Resource™. His diverse background in several fields includes an undergraduate, graduate, and postgraduate university education in architecture, community planning, and economic development planning. For years he was a consultant on community and economic development planning. For the past 15 years he has been an editor and publisher of magazines in the consumer electronics and architectural fields. Gary can be reached at 951 676 4914 or gary@ultimatehomedesign.com.

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- Acoustiblok, 6900 Interbay Boulevard, Tampa, Florida 33616, 813 988 7059, www.acoustiblok.com
- AFM Corporation, R-Control, 211 River Ridge Circle, Suite 102A, Burnsville, Minnesota 55337, 952 474 0809, www.r-control.com
- Agri Drain Corporation, 1462 340th Street, Adair, Iowa 50002, 800 232 4742, www.agridrain.com
- AID Sound Systems, Paul Hughes, 425 Lincoln Street, Santa Rosa, California 95401, 707 542 4406
- AKW, 5390 260th Street, Wyoming, Minnesota, 55092, 888 548 3259, www.akw-usa.com
- Amvic, Inc., 501 McNicoll Avenue, Toronto, Ontario, Canada M2H 2E2, 416 410 5674, www.amvicsystem.com
- Apricus Solar Company, 965 West Main Street, Branford, Connecticut 06405, 203 488 8216, www.apricus.com
- Aquacore, 604 East North Street, Elburn, Illinois 60119, 888 657 7788, www.aquacore.com
- Aqua Nueva International, 3628 Greystone Ridge Court, Rio Rancho, New Mexico 87124, 505 975 5008, www.aquaharvestonline.com
- Armacell LLC, 7600 Oakwood Street Extension, Mebane, North Carolina 27302, 800 866 5638, www.armacell.com
- Armstrong Wood Industries, 2500 Columbia Avenue, Lancaster, Pennsylvania 17604, 877 276 7876, www.armstrong.com
- Ashland Performance Materials, 5200 Blazer Parkway, Dublin, Ohio 43017, 614 790 3818, www.ashland.com
- A/V RoomService Ltd., Norman Varney/Harry Alter, 9282 Jug Street NW, Pataskala, Ohio 43062, 740 924 9321, www.avroomservice.com
- Bartlett Mechanical Services, Don Bartlett, 6755 Oak Street, Anderson, California 96007, 408 313 2486, www.bartlettmechanical.com
- Battens Plus, Inc., 530.620.5287, www.battensplus.com
- Bed Rock Concrete Pumping, P.O. Box 503, Point Arena, California 95468, 707 882 2637
- Bed Rock Products, Inc., 135 Hay Parkway, Point Arena, California 95468, 707 882 2323
- Bill Wilson Environmental Planning & Design,

LLC, 71 Del Casa Drive, Mill Valley, California 94941, 415 383 2919, 805 689 7639

- Broan-NuTone, 926 West State Street, Hartford, Wisconsin 53027, 800 548 0790, www.broan.com
- California Portland Cement Company, 2025 East Financial Way, Glendora, California 91741, 800 272 9119, www.calportland.com
- Carriage House Door Company, 1421 Richards Boulevard, Sacramento, California 95814, 866-890-1776, www.carriagedoor.com
- Carlisle Coatings & Waterproofing, Inc., 900 Hensley Lane, Wylie, Texas 75098, 800 527 7092, www.carlisle-ccw.com, 707 785 3438, www.
- CETCO Lining Technologies, 2870 Forbs Avenue, Hoffman Estates, Illinois 60192, 800 527 9948, www.cetco.com
- CNA Metalworks, Inc., Chris Attchison, 35550 Verdant View, The Sea Ranch, California 95497, cnametalworks.com
- Conservation Technology, Inc., 2633 North Calvert Street, Baltimore, Maryland 21218, 800 477 7724, www.conservationtechnology.com
- CopperCraft, 404 E. Dallas Road, Grapevine, Texas 76051, 800 486 2723, www.coppercraft.com
- Cosella-Dörken Products, Inc., 4655 Delta Way, Beamsville, Ontario, Canada LOR 1B4, 905 563 3255, www.cosella-dorken.com
- Daltile Corporation, 2303 Merced Street, San Leandro, California 94577, 510 346 7260, www.daltileproducts.com
- Day4 Energy, Inc., Suite 101, 5898 Trapp Avenue, Burnaby, BC, V3N 5G4 Canada, 604 759 3294, www.day4energy.com
- Dietrich Metal Framing/Dietrich Industries, 200 West Old Bridge Road, Columbus, Ohio 43085, www.dietrichmetalframing.com
- Dimension One Spas, 2611 Business Park Drive, Vista, California 92081, 800 345 7727, www.d1spas.com
- Dimplex North America Ltd., 1367 Industrial Road, Cambridge, Ontario, NIR 7GB Canada, 519 650 3630, www.dimplex.com
- DOW Chemical Company, 4847 Hopyard Road, Pleasanton, California 94588-2713, www.dow.com
- Dyna-Crete, 7343 Ricks Drive, Valley Springs, CA 95252, 209 938 0125, www.dynacrete.com
- EcoVantage EcoPrem, 6878 CR 62, St. Joe, Indiana 46785, 260 337 0338, www.ecoprem.com
- 88HVAC, Matt Jung, 1760 Marion Avenue, Novato, California 94947, 415 215 0533, www.88hvac.com
- Equi=Tech Corporation, 18258 Redwood Highway, Selma, Oregon 97538, 877 378 4832, www.equitech.com
- Euclid Chemical Company, 19218 Redwood Road, Cleveland, Ohio 44110, 800 321 7628, www.euclidchemical.com
- Frazee Paint, 625 Miramar Road, San Diego, California 92121, 858 626 3600, www.frazee.com
- Feeney Construction, John Feeney, 14660 McCourtney Road, Grass Valley, California 95945, 530 477 7647, 530 263 0039
- Finnleo Sauna & Steam, 575 East Cokato Street, Cokato, Minnesota 55321, 800 346 6536, www.finnleo.com
- Firestone Specialty Products, 250 West 96th Street, Indianapolis, IN 46260, 317 791 3390, www.firestonesp.com
- FORTA Corporation, 100 Forta Drive, Grove City, Pennsylvania 16127-6399, 800 245 0306, www.fortacorp.com
- Fortifiber Building Systems Group, 300 Industrial Drive, Fernley, Nevada 89408, 775 333 6400, www.fortifiber.com
- Georgia Pacific, 55 Park Place, Atlanta, Georgia 30303, 800 284 5347, www.gapac.com
- GetWireless LLC, 10901 Red Circle Drive,

Suite 325, Minnetonka, Minnesota 55343, 800 990 9025, www.getwirelessllc.com

- GRK Canada Limited/GRK Fasteners, 1499 Rosslyn Road, Thunder Bay, Ontario P7E 6W1, Canada, 800 263 0463, www.grkfastenersys.com
- Gutter Helmet/Southeastern Metals (SEMCO), 1180 Industry Drive, Jacksonville, Florida 32218, 904 757 4200, www.gutterhelmet.com
- Headwaters Resources, 10653 South River Front Parkway, Suite 300, South Jordan, Utah 84095, 888 236 6236, www.flyash.com
- iBeam Systems, Inc., 280 North 8th Street, Suite 30, Boise, Idaho 83702, 800 403 0688, www.ibeamsystems.com
- Industrial Acoustics Corporation (IAC), 1160 Commerce Avenue, Bronx, New York 10462, 718 931 8000, www.industrialacoustics.com
- In-O-Vate Technologies, Inc., 810 Saturn Street, Unit 21, Jupiter, Florida 33477, 888 44 DRYER, 561 743 8696, www.dryerbox.com
- Johnson Hardware/LE Johnson Products, Inc., 2100 Sterling Avenue, Elkhart, Indiana 46516, 800 837 5664, www.johnsonhardware.com
- Kährs, 940 Centre Circle, Suite 1000, Altamonte Springs, Florida 32714, 407 260 9910, www.kahrs.com
- Kohler Company, 444 Highland Drive, Kohler, Wisconsin 53044, 920 457 4441, www.kohler.com
- KraftMaid Cabinetry, Inc., 15535 South State Avenue, Middlefield, Ohio 44062, 440 632 5333, www.kraftmaid.com
- Kryton Canada Corporation, 8280 Ross Street, Vancouver, B.C., Canada V5X 4C6, 604 324 8280, www.kryton.com
- Lindal Cedar Homes, Inc., 4300 South 104th Place, Seattle, Washington 98178, 800 426 0536, www.lindal.com/sunrooms
- L.M. Scofield Company, 1651 East Fourth Street, Unit 229, Santa Ana, California 92701, 714 568 1870, www.scofield.com
- Mapei, 1144 East Newport Center Drive, Deerfield Beach, Florida 33442, 800 426 2734, www.mapei.us
- MaxiTile Inc., 849 East Sandhill Avenue, Carson, CA 0746, 310 217 0316, www.maxitile.com
- Mendocino Coast Plumbing, Jerry Moyles, P.O. Box 41, Manchester, California 95459, 707 882 2628, 707 353 2628
- Monster Cable Products Inc., 455 Valley Drive, Brisbane, California 94005, 415 840 2000, www.monstercable.com
- MoonDance Painting, Steve Stiles, 888 977 2468, 925 383 4537, www.moondancepainting.com
- Navien America, Inc., 1371 Santa Fe Drive, Tustin, California 92780, 714 258 9005, www.navienamerica.com
- Nisus Corporation (Bora-Care), 100 Nisus Drive, Rockford, Tennessee 37853, 800 264 0870, www.nisuscorp.com
- No-Burn Inc., 1392 High Street, Suite 211, Wadsworth, Ohio 44281, 330 336 1500, www.noburn.com
- Norbord Industries Inc., 1 Toronto Street, Suite 600, Toronto, Canada M5C 2W4, 416 360 2236, www.norbord.com
- Oregon Shepherd LLC, 12589 Highway 30, Clatskanie, Oregon 97016, 503 728 2945, www.oregonshepherd.net
- Orenco Systems, Inc., 814 Airway Avenue, Sutherlin, Oregon 97479, 800 348 9643, www.orenco.com
- OSI Sealants, Inc./Henkel Corporation, 32150 Just Imagine Drive, Avon, Ohio 44011, 800 499 3089, www.osisealants.com
- Owens Corning, 1 Owens Corning Parkway, Toledo, Ohio 43659, 800 438 7465, www.owenscorning.com
- Phase Change Energy Solutions, BioPCM, 120 East Pritchard Street, Asheboro, North

Carolina 27203, 336 629 3000, www.phasechangeenergy.com

- PEARL Protected, 730 Peachtree Stree, NE Suite 850, Atlanta, Georgia 30308, 800 374 5737, www.pearlprotected.com
- Pella Corporation, 102 Main Street, Pella, Iowa 50219, 641 621 6577, 5700 Commerce Boulevard, Rohert Park, California 94928 707 588 0140, www.pella.com
- Rosebud Studios, Ed Rose, P.O. Box 432, The Sea Ranch, California 94597, 707 865 1146
- Russell Pepper Plumbing, P.O. Box 152, Hathaway Pines, California 95233, 209 768 4551
- Portland Cement Association, 5420 Old Orchard Road, Skokie, Illinois 60077, 847 966 6200, www.cement.org
- QUALCON, Travis Swithenbank, P.O. Box 566, 333 East Pine Street, Fort Bragg, California 95437, 707 964 5000
- Rainhandler/Savetime Corporation, 2710 North Avenue, Bridgeport, Connecticut 06604, 800 942 3004, www.rainhandler.com
- Revere Copper Products, Inc., One Revere Park, Rome, New York 13440-5561, 800 448 1776, www.reverecopper.com
- Roth Global Plastics/FRALO, P.O. Box 245, Syracuse, New York 13211, 866 943 7256, www.roth-global.net
- RSF Fireplaces/Industrial Chimney Company, 400 J-F Kennedy, St. Jerome, Quebec, J7Y 4B7 Canada, 450 565 6336, www.icc-rsf.com
- Seepage Control, 7301 West Boston Street, Chandler, Arizona 85226, 800 214 9640, www.seepagecontrol.com
- Serious Materials, 1250 Elko Drive, Sunnyvale, California 94089, 408 541 8102, www.seriousmaterials.com
- SipBuilder, Mic Carmichael, 13650 Empress Road, Nevada City, California 95959, 530 265 6027, 530 277 8847, www.sipbuilder.com
- Smart Drain, Drawer 2219, Columbia, Maryland 21045, 800 638 8582, www.smartdrain.com
- Spratt Plumbing, William "Willy" Spratt, P.O. Box 375, Avery, California 95224, 209 770 2139
- Spunstrand Incorporated, 620 North Post Street, Post Falls, Idaho 83854, 208 777 7444, www.spunstrand.com
- Steve Michelson Productions, Lobitos Creek Ranch, 2800 Lobitos Creek Road, Half Moon Bay, California 94019-2547, 650 726 2460, www.lobitoscreekranch.com
- Sierra Pacific Builders / Stevenson Electric, Roger Stevenson, 1340 Highway 4, P.O. Box 2642, Arnold, California 95223, 209 768 2100
- Southwest Electric Enterprises, Inc. (QuietCool/EnviroCool), 31235 Loretta Rd Unit C, Winchester, California 92596-9466, 888.784.3826, www.quietcoolfans.com
- StormTech, 20 Beaver Road, Suite 104, Wethersfield, Connecticut 06109, 888 892 2694, www.stormtech.com
- Stormwater Solutions, LLC / EcoRainSystems, Inc., 3940 Laurel Canyon Boulevard, Suite 856, Studio City, California 91604, 866 786 7690, www.stormh2osolutions.com
- Sylvan Source, 1509 Industrial Road, San Carlos, California 94070, 800.640.0469, www.sylvansource.com
- ThermaSAVE/IHSN, Inc, 4002 Helton Drive, Florence, Alabama 35630, 256 766 3378, www.thermapanel.net
- Tobias Stucco, 2930 Dutton Avenue, Santa Rosa, California 95407, 707 577 8196, www.tobiasstucco.com
- Trimline Building Products, 5315 SW 53rd Court, Portland, Oregon 97221-1937, 503 320 1155, www.trimline-products.com
- UltraGlas Inc., 9200 Gazette Avenue, Chatsworth California 91311, 800 777 2332,

www.ultraglas.com

- Unirac, Inc., 1411 Broadway Boulevard NE, Albuquerque, New Mexico 87102, 505 242 6411, www.unirac.com
- Uponor North America, 5925 148th Street West, Apple Valley, Minnesota 85254, 800 321 4739, uponor-usa.com
- VELUX America, Inc., 104 Ben Cassey Drive, Forth Mill, South Carolina 29708, 888 838 3589, www.VELUX.com
- Vulcan-Hart Company, P.O. Box 696, Louisville, Kentucky 40201, 800 814 2028, www.vulcanequipment.com/Vulcan

- Wasco Products, Inc., 22 Pioneer Avenue, Sanford, Maine 04073, 800 388 0293, www.wascoproducts.com
- WaterFurnace International, Inc., 9000 Conservation Way, Fort Wayne, Indiana 46809, 800 222 5667, www.waterfurnace.com, www.stormh2osolutions.com
- Weeks Drilling & Pump Company, Chris Thompson, 6100 Highway 12, Sebastopol, California 95472, 707 823 3184, www.weeksdrilling.com
- Weston Solutions, Inc., 750 Bunker Court, Suite 500, Vernon Hills, Illinois 60061, 847 918 4000,

- www.greengridroofs.com
- Whirlpool Corporation/KitchenAid, 2000 M63 North, Benton Harbor, Michigan, 49022, 269 923 5000, www.whirlpool.com
- Zurn Flo-Thru Operation, 116 Molly Rex Lane, Mooresville, North Carolina 28117, 704 799 7087, www.zurn.com