



# The First Optimum Performance Home™ site planning part V

Gary Reber

## Introduction

This is the fifth article in the series documenting the design and construction of the first Optimum Performance Home™. The project has been selected by the U.S. Green Building Council (USGBC) for inclusion in the national Leadership In Energy & Environmental Design (LEED®) for Homes pilot program, their new green build certification initiative.

The home will be built at The Sea Ranch, located in Sonoma County, along the Northern California coastline of the Pacific Ocean.

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 relationships

## synopsis

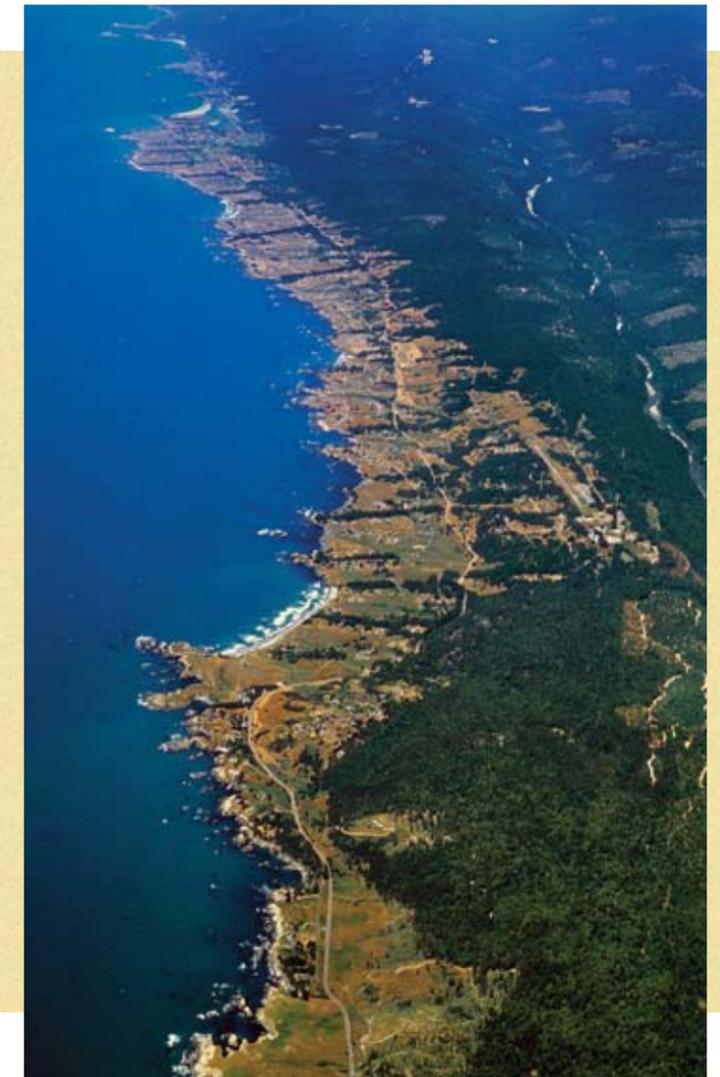
- The architectural/structural and grading/drainage submittals have been granted final approval with conditions that translate to clarifications on certain building components and material finishes.*
- The necessary work to address the remaining architectural/structural and grading/drainage, and landscaping concerns is nearly complete.*
- The mechanical infrastructure for the Optimum Performance Home™ is rather complex as several leading-edge technologies are employed to create the most energy-efficient design possible.*

between the home's components and the envelope they create. Also paramount is good stewardship—proper regard and respect for the rights of neighboring homeowners, resource efficiency, and the surrounding natural setting. 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 extended to 16 pages and covered extensively the project scope. Part II appeared in the March/April issue and focused on site planning and preparation. Part III expanded on the approach to Low-Impact Development (LID) for the site. Part IV appeared in Issue 4, July/August, and presented the Revised and Second Revised Final plan submittal to be reviewed by the Design Committee of The Sea Ranch Association. Part of the revisions included further refinement to the site plan and drainage design, which was hopefully the final condition to be met before the project would be permitted to be submitted to the Sonoma County Building Department for final structural and code approval, necessary to obtain a building permit.

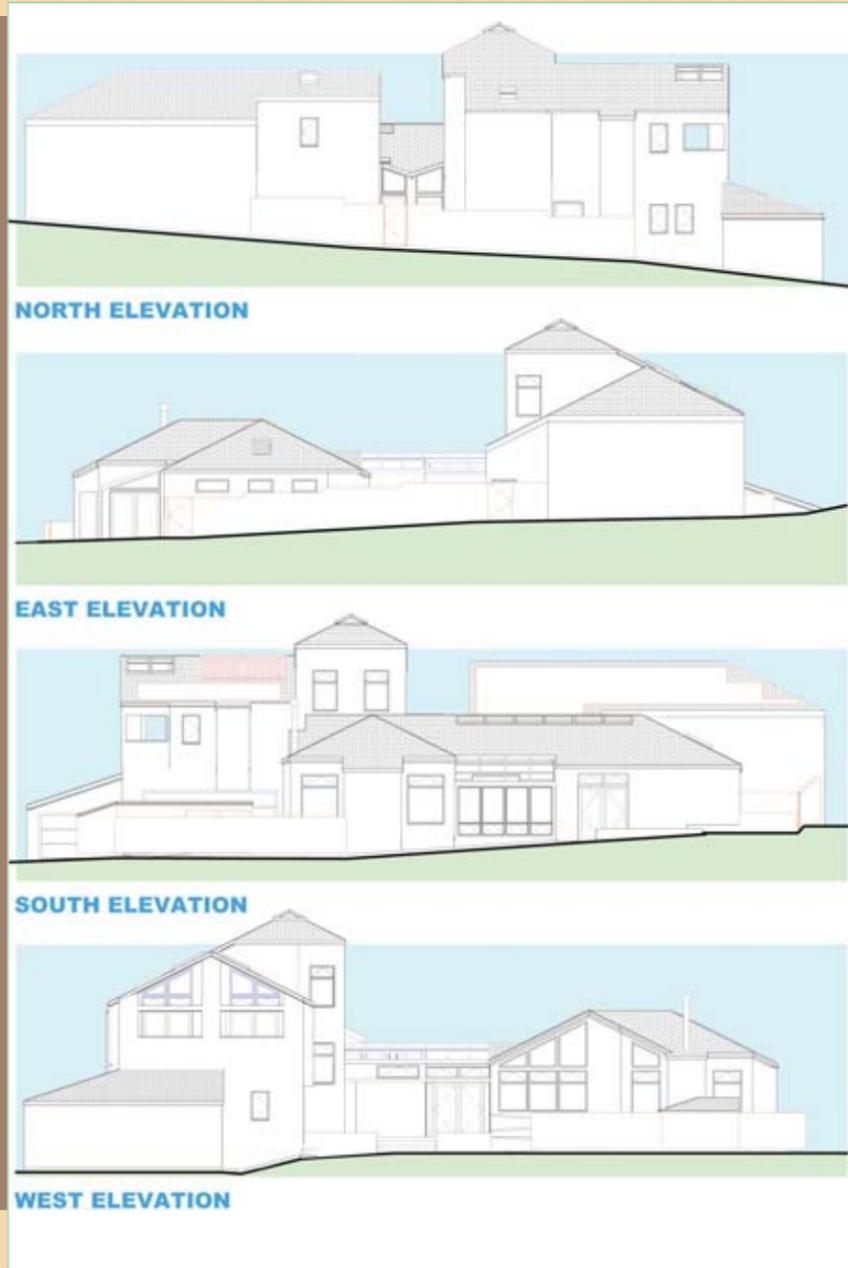
A letter, dated July 12, 2006, was received from The Sea Ranch Association Department of Design, Compliance & Environmental Management (DCEM) stating that the Revised and Second Revised Final

**"The science of optimum performance homes is about 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 Sea Ranch, Sonoma County, California

plan submittal for the proposed home, and the associated grading/drainage and landscape plans were reviewed by the Design Committee at their May 5, May 19, and June 16, 2006 meetings. The good news is that the architectural/structural and grading/drainage submittals have been granted final approval with conditions that translate to clarifications on certain building components and material finishes. The letter stated that, "These conditions can be removed by submitting revised drawings and details for review by Design Review staff." When conditions are resolved, a letter indicating Final Approval for TSRA Construction Performance Permit will be issued for presentation to Sonoma County to obtain a county building permit. The Design Team is completing, to the satisfaction of the Design Review staff, a Third Revised Final submittal as this issue is being published.



The elevations of the Optimum Performance Home at The Sea Ranch

The disappointing news is that, "The landscape plan is not approved at this time, due to a need for additional information. Specifically, the Design Committee has the following landscaping concerns, which must be addressed:

"1. There seems to be a lack of an overall concept or approach with how the landscape relates to the existing site vegetation and to the building mass. The Committee is relying on the landscaping to successfully mitigate the remaining issues with the overall size of the home. It is advised that you work with a landscape architect to develop a theme where the existing tree canopies are the base of the design, and additional like-kind species, and those of varying scales, are clustered together to create more natural-appearing formations. As you are aware, it will require careful planning and likely continual vegetation maintenance to retain solar access to rooftop PV panels.

"2. The relative graphic scale of plants shown on the landscape plan are not accurate and, therefore, not representative of the actual buffering capabilities of the plant form.

"3. Plants should be pulled closer to the edges of the perimeter building walls to have a more effective relationship in lowering the building mass.

"4. All new planting shall be installed with protective deer screens and a drip irrigation system to promote survival.

"5. Overlap tree canopies around driveway to better obstruct view up driveway toward house from road.

"6. Specify all planting intentions at planter beds as indicated on Sheet L-2.

"7. Distinguish existing vegetation to remain and any existing trees to be removed from proposed plantings on the Landscape Plan.

"8. All plans should have a north arrow for orientation purposes.

"9. South facade needs tree plantings for visual screening (as implied on

elevation drawing, Sheet L-3). Species indicated on plan are of inappropriate scale.

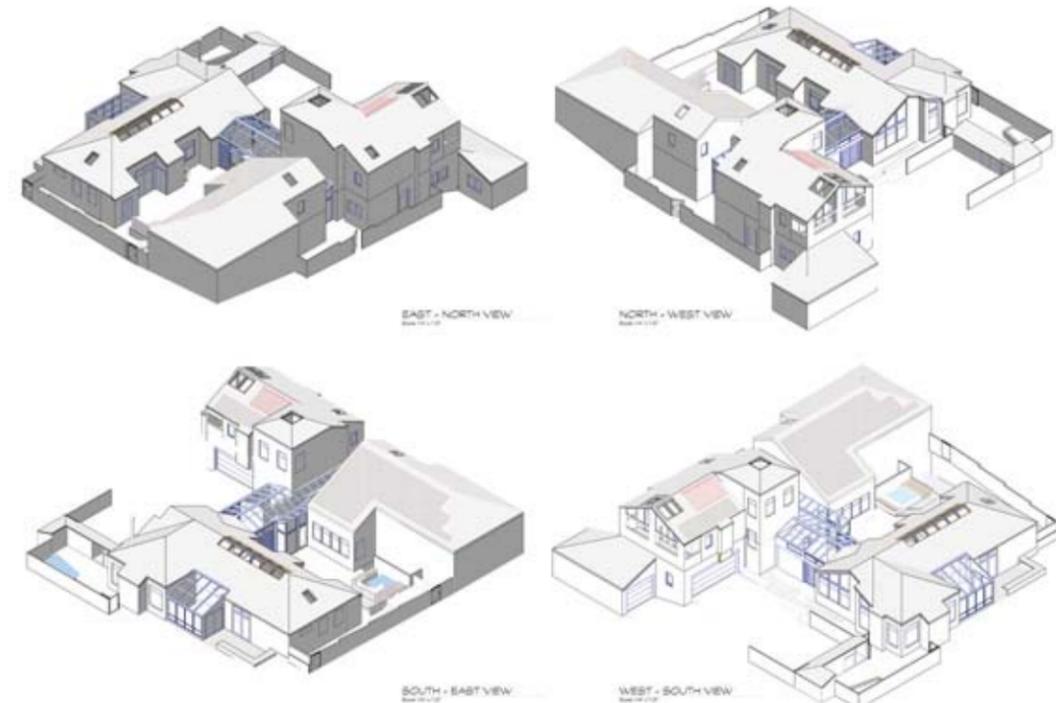
"10. Add erosion-control ground-cover plantings on cut-slope areas.

"11. Ensure that native plant species selected are suitable for damp/wet soil conditions.

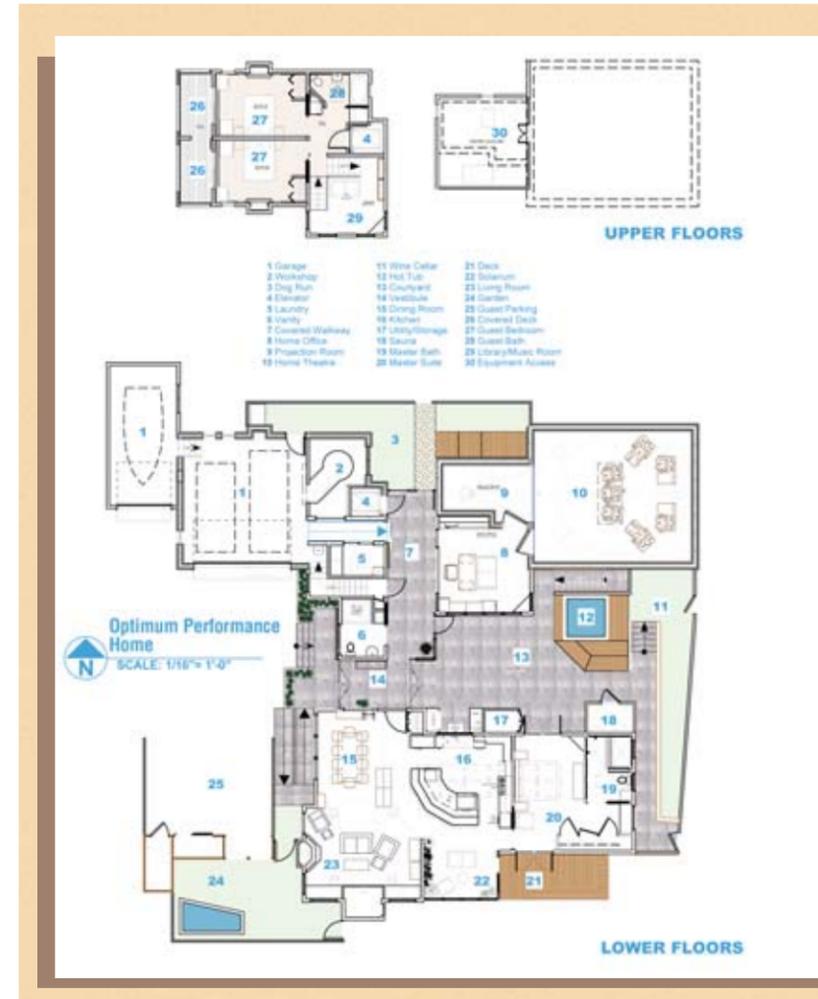
"12. Refer to plan mark-ups for possible additional issues not specifically itemized within this letter.

"A revised landscaping submittal will be required to address these issues. The Committee will allow the landscaping issues to be resolved independent of the building/grading issues in order to avoid further delay to the issuance of permits/commencement of construction."

Much of the concerns stated are subject to interpretation and have been fully addressed in the landscape plan submittal. If the Design Team could have been at the Design Committee meetings to discuss our proposals, we could have had a productive dialogue in which we could have provided further clarification of the plans submitted, provided reference documentation on plant species and their scale, and explained our design approach, which fully subscribes to the approved Sea Ranch Association Vegetation Management Plan, including adhering to selecting the allowable plant species designated specifically in this plan in accordance with the site's



Four perspective views of the Optimum Performance Home at The Sea Ranch





SOUTHWEST VIEW

A perspective of the southwest view created by architectural designer Ed Rose.

environmental conditions. And the Design Committee would have had the opportunity to educate us about their viewpoint and desires so that we could more effectively interact with them.

There has been so much wasted time, effort, and money that has

occurred in the Design Committee process with respect to this proposed project. Fully, three years, nine months have passed since the first site review and conceptual plan stage of the project. While this "approval" letter is dated July 12, a full four weeks preceded the

actual date of Design Committee approval on June 16. In our Design Team's experience, there is so much misunderstanding that comes from the exclusion of the property owner and design representatives. And as a result, there is so much needless pain and frustration, not to mention the escalating professional design and construction costs that are the result of the dragged-out design review process.

In any event, the Design Team is re-addressing with more clarification the concerns expressed and providing the additional information requested.

The necessary work to address the remaining architectural/structural, grading/drainage, and landscaping concerns expressed in the July 12 letter is nearly complete. This work includes the structural and mechanical plans for the Optimum Performance Home, necessary

as part of the plan submittal to Sonoma County.

Assuming that Sonoma County and The Sea Ranch Association's DCEM will not further delay the issuance of permits, the commencement of construction, site-grading, foundation, and

mechanical infrastructure could start by mid-October 2006.

In this, Part V of the case study series, the focus will be on the mechanical infrastructure planned for the Optimum Performance Home.

### Mechanical Infrastructure

As noted in the previous articles in this series, the home design integrates all of the concepts advocated in *Ultimate Home Design*™. The goal is to demonstrate how today's products and



LANDSCAPE/SITE PLAN

## "My goal is to build a house that requires no heating system."

THIS HOUSE IS BUILT WITH ENERGY-EFFICIENT ARXX WALLS AND FOUNDATIONS. ARXX IS THE INSULATED CONCRETE WALL SYSTEM WITH A 13-YEAR TRACK RECORD. ARXX WALLS CAN PRODUCE INSULATION VALUES EQUIVALENT TO R-50 OR MORE\*. ARXX WALLS PROVIDE COMPLETE DESIGN FLEXIBILITY AND CAN BE CLAD IN ANY FINISH. BECAUSE ARXX IS A PROVEN SYSTEM, CONSTRUCTION OF AN ARXX HOME IS COST-EFFECTIVE AND EASY TO MANAGE. BUILD THE FUTURE, NOW. BUILD WITH ARXX.



### "This is the future."

"My goal is to build a house that requires no heating system. One that relies on passive solar heat and the heat generated by the people living in the home. I know this is realistic and achievable with today's technology. I've built my reputation on building 'Green' homes since 1984 in Whistler, B.C., Canada. How? By using Arxx ICF's to build the foundations and all exterior walls. This airtight construction can produce insulation values equivalent to R-50 or more, and is environmentally responsible building that's simple to design and construct. It's energy-efficient, sustainable, healthy, economical to maintain, and produces far less waste than wood-frame construction. This is the future."

— Rod Nadeau, Innovation Building Group Ltd.



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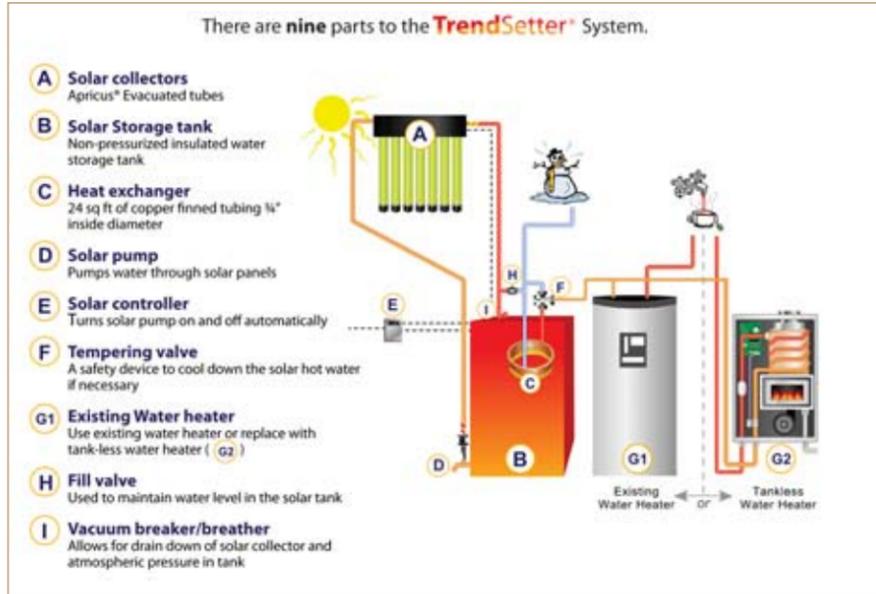


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ULTIMATE HOME DESIGN  
The Optimum Performance Design & Build Resource  
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building methods can make life safer, more comfortable, and more enjoyable. The science of optimum performance homes is about 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 holistic design, the house will serve as a home for many people and serve in many phases in one's life.

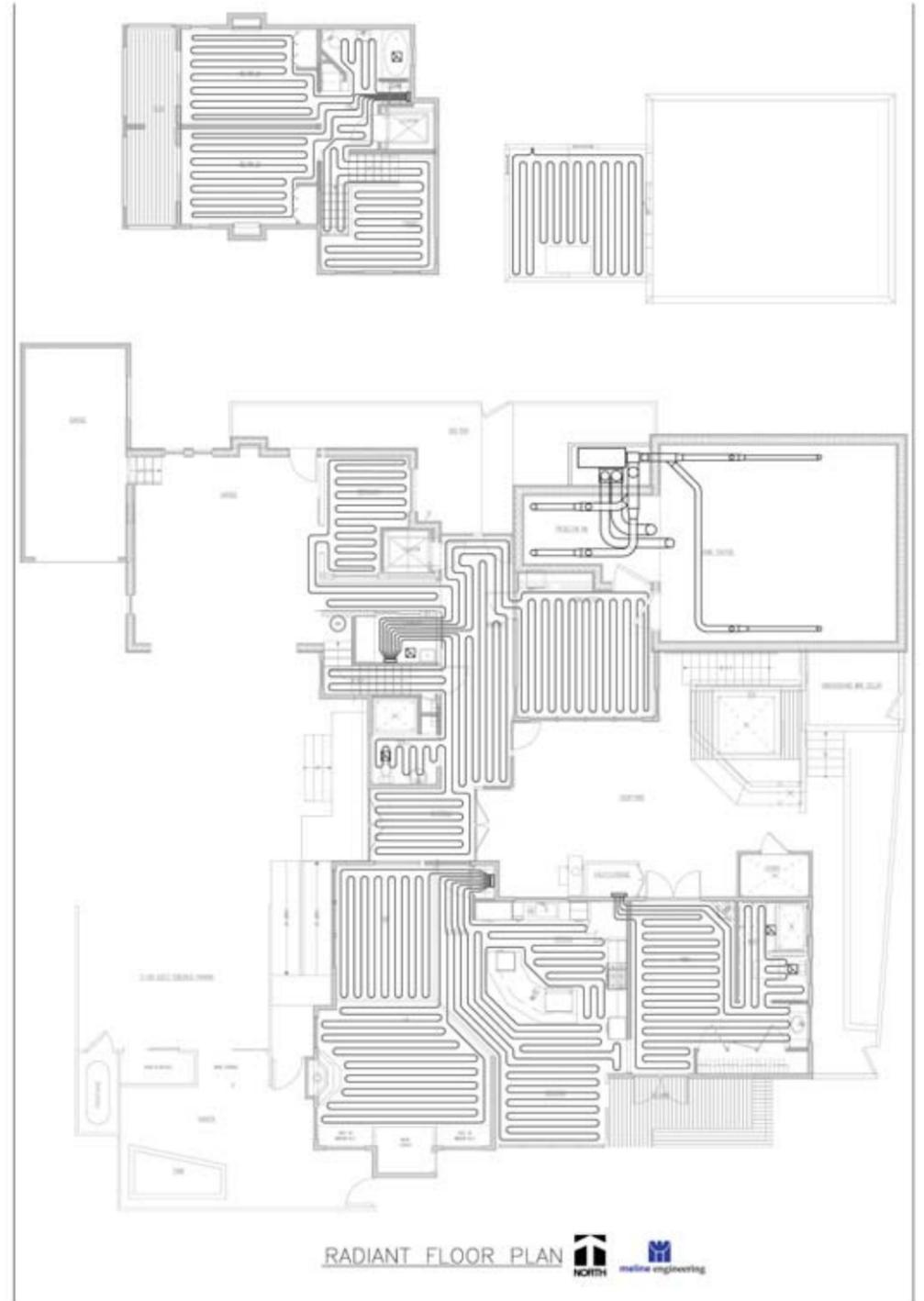
The Optimum Performance Home's site plan is designed to strongly support the efficient use of the community's water supplies, equitable allocation of water resources provided by the

community and harvested on-site, elimination of water pollution and contamination from poorly-designed or failing septic systems, and general land use patterns that conserve and protect water resources within the overall ecosystem at The Sea Ranch. The water-efficient site plan and drainage design promotes "smart water use."

The mechanical infrastructure for the Optimum Performance Home employs several leading-edge technologies to create the most energy-efficient design possible. The home is designed to cut its energy use with efficiency, and then meet the remaining needs with renewable energy sources.

This includes on-site energy generation in the form of a 4.4-kilowatt (kW) MyGen™ Meridian® photo-voltaic (PV) roof-integrated solar panel system by Kyocera Solar, Inc., operated and managed using a GridPoint™ Connect Series hub for the renewable system's connection to the Pacific Gas & Electric (PG&E) utility grid and for online Internet energy management. This installation will be capable of generating near-zero energy home (ZEH) cost operation, if not zero-energy home cost, for the electricity use in the home. The ZEH design is based on the Solar Buildings Program of the U.S. Department of Energy.

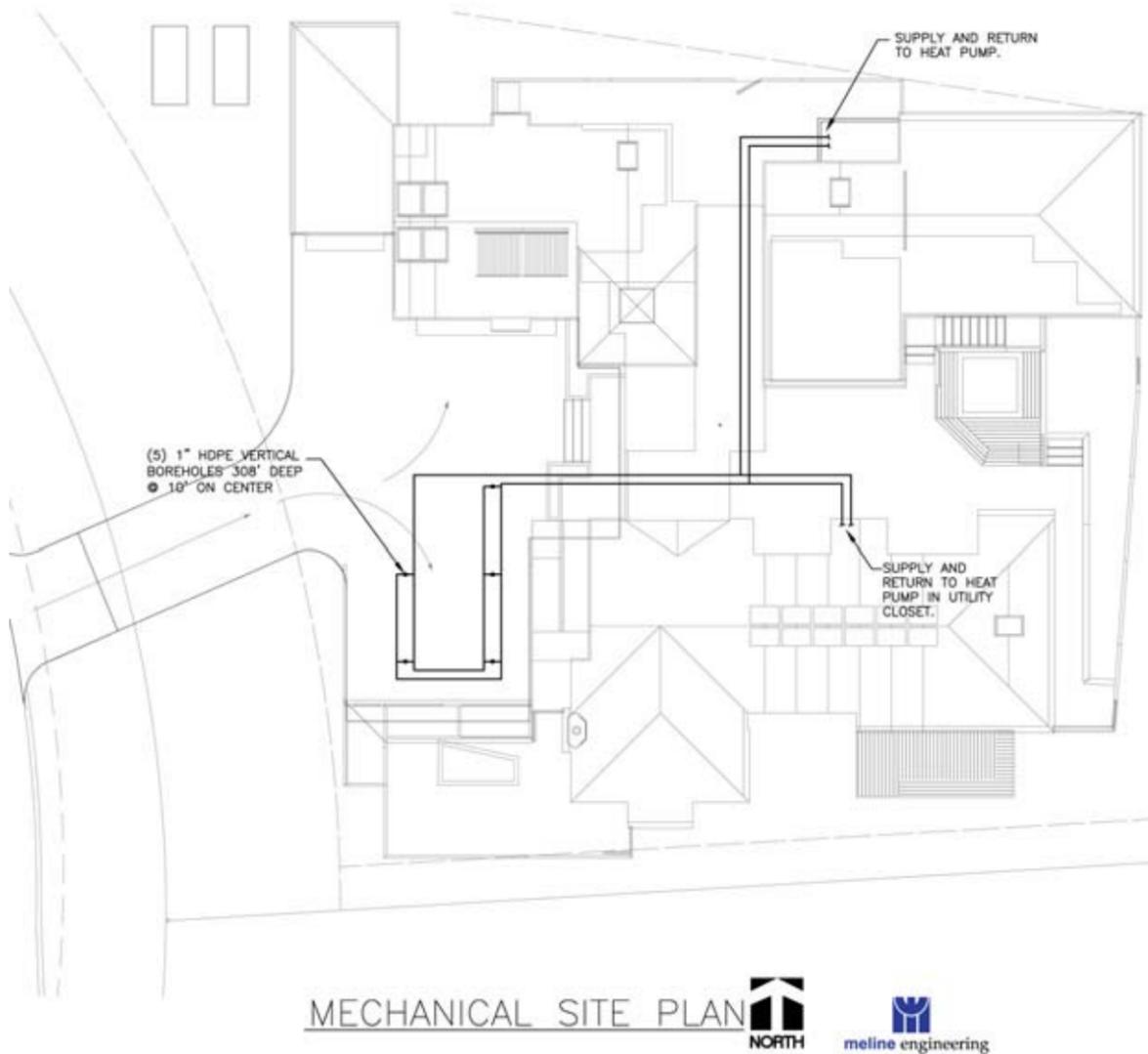
Net metering allows the electric meter to spin backward and forward, meaning



that at times the home will pull (and pay for) power from the electric grid, and at other times it will produce more energy than it will need, with the excess being sold to the electric company, resulting in an annual net-zero energy cost. It is expected that the home will generate more electricity than it uses. The GridPoint intelligent management system is

designed to continue providing electricity even during blackouts.

Solar hot water preheating will be provided by TrendSetter® Industries, Inc. using two AP-30 Apricus® Solar Collectors. A ground-coupled heat pump will be system-integrated to maintain the domestic hot water temperature for the main house and laundry. A 200-gallon



### Kyocera Solar MyGen™ Meridian® Roof-Integrated Solar Electric Generation System

- The high-efficiency d.Blue MyGen Meridian solar system visually blends with the Optimum Performance Home's architecture and black slate roofing, becoming an energy-producing enhancement. Kyocera backs the easy-maintenance cassette system with a 25-year limited warranty on power output. The system is Class A fire rated for all roof pitches.



### Gridpoint™ Connect Series

- The GridPoint Connect Series is the first appliance to intelligently manage renewable energy and provide instant backup power. The unit seamlessly combines power electronics, high-capacity battery storage, and an Intel® Pentium®-based computer. The appliance actively communicates with GridPoint's network operations center to ensure optimal performance. The result is reliable power in the event of an outage and an intelligent and automatic way to monitor solar electric use.



### TrendSetter® Industries' AP-30 Apricus® Evacuated Solar Tube Collectors & Solar Thermal Storage Tank

- TrendSetter solar tube systems reduce the water heating portion of a utility bill by as much as 90 percent. The composite aluminum tank features a seamless high-temperature EDPM lining, all-copper/cupro-nickel fittings, rigid foam insulation, stainless-steel fasteners, and silver-brazed joints, and is warranted for 20 years with an indefinite life expectancy.



### Spunstrand® Filament Wound Fiberglass Underslab Duct

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



TS-200 TrendSetter Solar Thermal Storage Tank will supply preheated water. The weather resilient tank will be buried outdoors under the courtyard. TrendSetter solar hot water systems are unique in their scalability from 100 to 1,200 gallons of storage; they are up to ten times more efficient than other systems.

A Takagi T-H1 ENERGY STAR®-qualified on-demand instantaneous tankless water heating system will be used for the guest area above the garage in Building 3 of the three-building compound with a Takagi T-K Jr. providing on-demand hot water at the outdoor shower sourced from harvested and filtered rainwater.

Geothermal energy will be harnessed with a ground-coupled vertical closed-loop system designed by Meline Engineering, which circulates water from the earth to extended range water source heat pumps manufactured by WaterFurnace International, Inc. An EW Series water-to-water heat pump will be used for the whole-home zoned radiant floor heating system. An E Series water-to-air heat pump will provide air conditioning to the dedicated home theatre and projection room in Building 2. The WaterFurnace system also will serve as a back-up domestic hot water source.

The WaterFurnace closed-loop system circulates water through a "loop" of small-diameter, underground pipes made of high-density polyethylene. Closed-loop systems can be installed either horizontally or vertically, or even in a pond. In the case of the Optimum Performance Home, the system will be installed vertically under the guest parking area. The ground-loop portion of the geexchange 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. The ground loop replaces the "outdoor unit" of a conventional air-to-air heat pump.

Spunstrand special underslab low-velocity insulated ducts for ultra air flow quietness will channel the air-conditioning to the dedicated home theatre and projection room.

The AQUAPEX® PEX radiant floor heating, AQUAPEX PEX plumbing, and AQUAPEX PEX fire sprinkler system to be installed in the Optimum Performance Home are designed and manufactured by Uponor. PEX is cross-linked polyethylene. PEX flexibility and strength at temperatures ranging

from below freezing up to 200-degrees Fahrenheit makes it an ideal piping material for hot and cold water plumbing systems, trouble-free firesprinkler systems, and hydronic radiant floor heating systems.

As part of the Uponor PEX plumbing system, an Aquacore® Whole Home Ultra Filtration System and a Sylvan Source M-600 Ultra-Clean Water System will be integrated. The Aquacore ultrafiltration system produces 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.

A Sylvan Source M-600 will further purify the ultrafiltered water produced by the Aquacore system and serve as the ultrapure water source for ice makers, refrigerators, and kitchen faucets.

The mechanical system design will include a whole-home Broan SmartSense Ventilation System 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, and garages. The SmartSense Ventilation System performs as an energy recovery ventilation (ERV) system to provide fresh air while exhausting stale air and filtering dust and indoor air pollutants. The Broan system operates automatically and employs patent-pending sensing technology to regulate the volume of fresh air ventilation and maintain a constant humidity level in the home.

A dedicated ENERGY STAR-qualified Panasonic WhisperComfort™ ceiling-mounted spot ERV fan will be used in the home theatre to provide fresh air while exhausting stale air.

Title 24 documentation is being provided by Sol Data based in Santa Rosa, California. Their load calculations will be used to coordinate equipment selections for overall home compliance with the 2005 California Building Energy Efficiency Standards.

Propane gas will be used as the source for two gas-operated cooking appliances: an ENERGY STAR-qualified KitchenAid® Architect Series®



### Takagi T-H1 ENERGY STAR®-Qualified Tankless Water Heater

- The Takagi T-H1 provides a never-ending supply of 120-degree Fahrenheit water in the most efficient way possible.



### WaterFurnace EW & E Series Heat Pumps

- The Optimum Performance Home™ will use a WaterFurnace EW Series heat pump to boost the solar hot water temperature (as needed) for both the whole-home radiant floor heating and domestic hot water heating systems. An E Series water-to-air heat pump will be used to provide air conditioning to the home theatre and projection room.



### 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.



### 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.

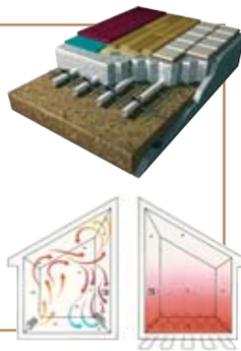
### Wardflex® Flexible Fuel Gas Tubing

- Wardflex® is the gas piping system for the 21st Century with the highest overall rated flow capacity in the industry. Wardflex is recognized as the "system of choice" by major gas utility companies.



### Uponor® Radiant Floors

- Warm water circulates under the floors throughout the Optimum Performance Home™ using Uponor's durable, flexible, and resilient crosslinked polyethylene AQUAPEX tubing, providing a comfortable, even heat without stirring up dust and pollutants.



### Uponor® AQUAPEX® Plumbing System

- AQUAPEX tubing is clean, does not corrode, and is not affected by corrosive water and soil. In addition to being a healthier way to move water through the Optimum Performance Home™, it is also quiet, durable, virtually maintenance free, and guaranteed for 25 years.



### Uponor® Fire Protection System

- Uponor's reliable and trouble-free fire sprinkler system is designed for fast response. The AQUAPEX plumbing system provides water to the sprinkler fixtures, which activate independently when temperatures reach 150-degrees Fahrenheit. The system exceeds the National Fire Protection Association (NFPA) requirements.



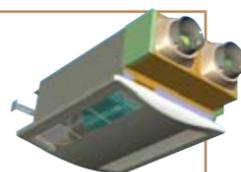
### Broan® Ultra Silent Sensing Fan

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



### Panasonic WhisperComfort™ Ceiling-Mounted Spot ERV

- The ENERGY STAR®-qualified WhisperComfort fan provides whole-home fresh air ventilation with its energy recovery ventilation (ERV) core technology. The ERV unit delivers fresh air while exhausting stale air and filtering out dust and indoor air pollutants.



KDRP767R dual-fuel 36-inch-wide range with steam-assist will be the primary cooking appliance and a professional AGM36 manually controlled 36-inch-wide griddle manufactured by Wolf Range Company will serve as an exhibition Japanese Teppan-Yaki cooktop. These two appliances will be supplied propane gas using Wardflex® flexible corrugated stainless-steel fuel gas tubing. A Broan® professional ISER222SS 51.5-inch wide stainless-steel island hood rated at 1000 CFM will provide exhaust for the AGM36, and a Broan professional KER22242SS 42-inch wide stainless-steel wall hood rated at 1000 CFM will provide exhaust for the KDRP767R. The controls for both hoods are operable via remote control to support the universal design requirements of the Optimum Performance Home.

Lisa Meline of Meline Engineering, based in Sacramento, California, is the mechanical engineer on the Design Team. The plumbing contractor, experienced in radiant floor heating and PEX plumbing, is Rick O'Neil of Tom's Plumbing in Gualala, California, just north across the Gualala River from The Sea Ranch. Mike Ericksen and Mark and Beth Morelli of Air Connection in Santa Rosa, California will provide the installation of the WaterFurnace geothermal system.

The article, which follows, is written by Lisa Meline with a focus on the mechanical engineer's role on the Design Team. An article written by Norm Ehrlich, Founder and Chief Technical Officer of TrendSetter Industries, Inc., appears elsewhere in this issue and covers the selection and application of solar water heating systems.

### Next

As stated previously in past articles, the design review process itself has no doubt weighed us down over this unexpectedly long period of time. But, now that the Design Committee has granted essentially final approval, though with conditions that pose no insurmountable challenges, the project should now move forward in a hastened manner, so that commencement of construction can begin by mid-October. The next series of articles will focus on each stage of construction and the design approach taken, and the technologies and building systems and materials used to create the first Optimum Performance Home. **UHD**

## The Mechanical Engineer's Role

Lisa Meline, PE

### Energy Management

The mechanical engineering professional is an important player on the custom home design team. Mechanical engineering is at the crossroads of all engineering disciplines, with formal education in topics also covered by electrical, civil, and structural engineering programs. Many mechanical engineers also have had basic courses in controls, acoustics, and environmental topics.

The core of the mechanical engineer's value on a custom home design team is his or her role in managing energy: solar, electricity, petroleum-based products, and sometimes wind. The mechanical engineer must be familiar with the standard building codes in the state in which he or she is licensed. For example, I am licensed in California and must be familiar with California's Building Energy Efficiency Standards, which were recently updated to be more restrictive, especially in the residential arena. By code, the mechanical engineer is one of several design professionals required to specify the energy efficiency of the home building materials, lighting, and mechanical systems. He or she must also maintain the aesthetics required of the custom home designer and the comfort desired by the owner.

The innovation and technology in the custom home industry has become more complex. There are new building materials that must be modeled for their heat transfer characteristics. Because homes are built "tighter" than in the past, this introduces a new challenge in mechanical system design,

which is to provide the necessary ventilation of fresh air. Good ventilation improves indoor air quality and can mitigate issues with mold.

Many of the high-end homes are moving toward total home control or smart home controls, as is the case with the first Optimum Performance Home™ at The Sea Ranch. This type of system can control anything from the security system and lighting to the volume of built-in sound and video systems, inside and out.

All of these design elements need to be coordinated with the mechanical engineer. On the design team, the mechanical engineer is usually responsible for the plumbing system design; heating, ventilation, and air-conditioning (HVAC) design, sequence of operation for the control system design; and, in most cases, the energy calculations, which show compliance with the Building Energy Efficiency Standards (often called, in California, Title 24 documents). The mechanical engineer creates his or her system design with input from other specialty professionals on the custom home design team, such as the home theatre designer, humidifier and wine cellar consultants, kitchen designers, and pool and spa builders. The mechanical engineer also coordinates the mechanical equipment requirements with the electrical engineer to make sure that the electric service to the home is of the proper size. The dividing line between the civil engineer and the mechanical engineer relative to the plumbing design is usually drawn at a five-foot perimeter around the house. The mechanical engineer determines the sewer, water,

and gas (if applicable) requirements of the home and coordinates this with the civil engineer to ensure that the proper size and capacity of the utilities are brought on site and the proper connections are provided for the home. Because of the open space of some custom home designs and often the home's geographic location in anticipated seismic activity zones, piping and plumbing within a custom home can often be a challenge to the integration of a duct distribution system.

### Geothermal Energy Use In The Optimum Performance Home™

For this particular design of the Optimum Performance Home at The Sea Ranch, a geexchange system manufactured by WaterFurnace International, Inc. was 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 International); a closed-loop vertical "well" system, which is drilled into the constant temperature earth on site; and water, which is circulated between the ground loop and the heat pump in high-density polyethylene pipe. The ground-loop portion of the geexchange 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

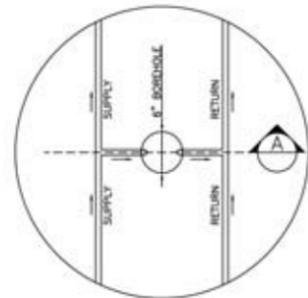


Shown is a typical water-to-water heat pump installation for a radiant floor system. The hot water heater to the left is used as a buffer tank for the radiant floor system.

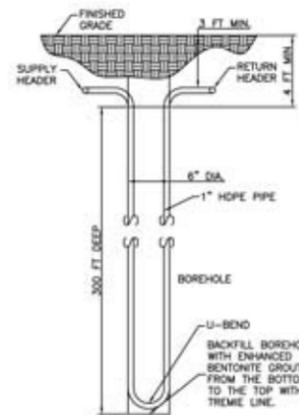
same type of refrigeration cycles as conventional HVAC equipment. The difference is that the ground-coupled heat pump can take 1 kilowatt (kW) of electricity and turn it into 3 to 4 kW of heating energy for the home. This rating is called the coefficient of performance (COP), and for geexchange systems, the performance is usually between 3 and 4 COP. On the Optimum Performance Home project, the water-to-water ground-coupled heat pumps will be making hot water to be distributed through the home in a radiant floor distribution system manufactured by Uponor. All of the rooms except the home theatre and the projection room will have radiant floor heating. The home theatre and the projection room will be heated and cooled with a two-zone water-to-air ground-coupled heat pump. This type of system was selected for the home theatre and projection room because it is expected that more continuous cooling will be required to offset the heat created by the home theatre projection and audio equipment. Both of these heat pumps will be connected to a single ground-loop system. The ground-loop system will allow

the heat pumps to operate in heating and cooling modes simultaneously.

The mechanical engineer will be responsible for selecting the mechanical equipment, designing the radiant floor and duct distribution systems, and providing basic control sequences for the builder. The mechanical engineer is also responsible for sizing the ground loop. The ground-loop piping will be buried between 3- and 4-feet below finished grade in the guest parking area. It will be a series of vertical 1-inch diameter high-density polyethylene tubing drilled down into the earth to 250- to 300-foot deep placed at roughly 10- to 15-foot centers. Water will be circulated within this 1-inch diameter high-density polyethylene closed-loop pipe to transfer heat from the earth to the heat pumps in the house. In cooling mode, the water will be circulated between the heat pumps in the house and the earth, to reject heat back into the earth. If both units are operating simultaneously, the heat rejected from the water-to-air heat pump in the home theatre (cooling) will be transferred directly to the water-to-air heat pump, making hot water for the radiant floor.



GEOTHERMAL BOREHOLE  
SCALE: NONE



A GEOTHERMAL BOREHOLE SECTION  
SCALE: NONE

In addition to being energy efficient, the ground-loop portion of the geexchange system is all below ground and out-of-sight. Essentially, the ground loop replaces the "outdoor unit" of a conventional air-to-air heat pump. There is no noisy equipment outside the home to detract from the beautiful Sea Ranch setting of this Optimum Performance Home.

The geexchange system will also be used as a backup-heating source for the domestic hot water system. The solar thermal system designed by TrendSetter Industries, Inc. will be heating water and storing it in a large tank buried outside the home beneath the courtyard. On days where the energy from the sun cannot be used, the geexchange system will be engaged to maintain the hot water temperature in the solar hot water storage tank. This

ensures that when additional energy is required to heat the hot water it will operate at a COP of about 3 rather than a COP of 1, which is the efficiency of an electric resistance hot water heater.

The challenges of integrating this system into the Optimum Performance Home will lay mainly in interfacing with other trades on the project. The installation of the ground-loop system will need to be coordinated with the site development work. A drilling permit is usually required in addition to a construction permit for the ground loop portion of the geexchange system. The spoils resulting from the drilling process will need to be contained and, in some cases, hauled off the project site.

Since the geexchange system is essentially a "central plant" system, there will need to be integration with many of the systems in the home. Careful coordination will be required between the contractors providing the radiant floor system, sheet metal and under-slab ductwork, plumbing, controls, and solar system.

Because of the high level of coordination and unfamiliarity of many trades with the geexchange system, a contractor certified by the International Ground Source Heat Pump Association (IGSHPA) will install the system at the Optimum Performance Home site. The entire system will be commissioned by the engineer of record. It is very important that the system performance be verified to ensure its energy efficiency in accordance with California Title 24 documents. **UHD**

#### The Authors

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#### Acknowledgements

Ed Rose is a residential architectural designer. His company is Rosebud Studios based in Monte Rio, California. Ed has been designing homes and remodels on The Sea Ranch and surrounding areas since the late 1980s. His skill in listening to and understanding his client's architectural program and then translating that into a workable and pleasing design acceptable to the rigorous philosophy of The Sea Ranch Design Committee is responsible for the final successful approval of the First Optimum Performance Home™ at The Sea Ranch. This included the fairly new design concepts of universal access and aging-in-place, use of "green" materials, and meeting the exacting guidelines for a residential LEED® designation. It wasn't until Ed joined our team that we began to make progress with the Design Committee in this challenging process. Ed provided all of the images of the site plan, floor plans, elevations, and isometric perspectives for the magazine. His extensive education and experience span numerous disciplines from architecture to industrial and graphic design to technical illustration, photography, and painting. Ed can be reached at 707 865 1146 or 707 785 9180 or rosebud@thegrid.net.

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#### Product Information

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