

**How it started.** My husband Roger wanted to raise chinchillas for his second half of life, and we really liked the foothills near Denver. We bought our beautiful 35 acres in 1981, and decided to call our endeavor “Crystal Dawn Ranch.” The name reflected the crystal clear air, the beautiful sunrises we could see from the property, and the fact that we were about to build a ranch. We built the barn for the chinchillas over the next few summers, left California for a rental house in Golden late in 1985, and moved into the barn early in 1986. I’d been working on the floor plan for our dream house for a long time, my husband Roger did the engineering and drawings, and finally we built it in 1987. The house construction crew consisted of my husband Roger, one full-time carpenter, my 18-year-old stepson Kirk, and me, after work and weekends. Our two toddlers were underfoot all the time.

**A special place.** It was a wonderful place to raise our kids. Climbing up to and behind the Indian head rock formation was a favorite family activity. Each of us had special places on the property we liked to hike to and explore, or to just rest on a rock. The kids built forts out of fallen branches, gathered wildflowers each spring and summer, and collected fascinating rocks. Each fall we all worked to bring firewood down from the mountainside, cutting down dead trees, splitting and stacking the wood. The large house, and especially the great room, let us have friends and family up for holidays and summer gatherings. The large shop area in the basement was wonderful for large wood-working equipment and projects. The number and variety of birds at the birdfeeders on the main deck was amazing—three kinds of woodpeckers, three kinds of nuthatches, two kinds of chickadees, black-headed grosbeaks, several types of juncos, three kinds of hummingbirds, etc. Wildlife sightings included bear, bobcat, deer, elk, skunk, and lots of chipmunks and squirrels. We raised both goats and sheep at times (though we lost animals frequently to a mountain lion, a dog pack, and finally a stray wolf).

One of my greatest joys was hiking the property, and enjoying the wide variety of ecosystems within the 35 acres. The open hillside areas have prickly pear cactus, 5-inch-diameter barrel cactus, choke cherry, mountain mahogany, currant bushes, and other wildflowers. The shadier pine sections at higher elevation have kinnick-kinnick, ponderosa pines, blue spruce, and Douglas fir. The aspen grove has coyote mint, wild geraniums, heal-all, black-eyed susans, jacob’s ladder, pentstemons, and many other wildflowers. There are not many aspen stands along this side of Douglas Mountain, and our house sits in the largest aspen grove in the area. The aspens give us wonderful open woods to walk through, amazingly vivid trees every October that give a golden glow to the whole house, and a ready supply of excellent firewood.

The sky at night on the property is amazing. My youngest son and I often laid out on the grass in front of the house, learning the constellations. When my son got a 4-inch telescope, he studied the heavens from the front deck. Later my husband built our son a 22-inch telescope (yes, an amazing project) that he used on the deck, and for a short time, on a platform on the roof of the barn. The barn roof is actually the best place for star-gazing, and so we left the access walkway to the roof in place.

My daughter, now 32, grew up here, and offered me her memories: “One of my favorite memories of the house was sitting in the kitchen or out on the deck with Grandpa early in the morning to watch the birds wake up and come eat breakfast. Another favorite memory was waking up early and going downstairs to journal as the sun started to peak through the big open windows of the living room. Another of my most fond memories was laying on the couch falling asleep while I watched the fire in the fireplace. I also loved Christmas time when we would hang the big wreaths next to the fireplace and the

Christmas tree would take the tea table's place and light up the living and dining rooms. Most of my memories involve the property and the seasons.”

My oldest son and his family lived in the house a number of years after he grew up, raising goats, chickens, and his own kids. The wild predators can be a problem for livestock, and he built an intensive electric fence to protect them. His three children enjoyed the mountainside as much as the generation before. He built a fire pit in between the house and barn out of 24 curved landscape blocks, and we all enjoyed fires and marshmallows.

**Siting.** We sited the barn and house to be south-facing for passive solar gain. The barn is nearly exactly facing south; the house is facing a little bit east of south. We chose the site among the aspens, to take advantage of the natural spring behind the barn. We also chose the site to avoid various large rock outcroppings, and to be accessible by a steep but manageable south-facing driveway (to melt the snow). We also wanted the house to be sheltered by the large pines.

**Construction methods.** Butch Ramstetter, from a local pioneer family and still living in Golden Gate Canyon, did the excavations and built the driveway. The barn was our test case for a relatively new construction method (in the early 1980s) called Q-bonding. Most of the barn, and the lower one-and-a-half levels of the house, were built with dry stack concrete blocks, 8x12x16. These were strengthened with rebar and poured with cement in a regular pattern, with pilasters added regularly along the long walls of the barn. The blocks that were not filled with rebar and cement were specially shaped to hold pieces of rigid insulation. After the wall was complete, generally both sides were covered with Q-bond, which is a cement-fiberglass mixture. The resulting construction made for incredibly strong walls.

The front of the barn was of standard 2x4 framing. The front of the middle level of the house (kitchen and great room) was also standard framing. The top level of the house was built with structurally insulated panels (SIPs), for better energy efficiency.

**Barn design.** The barn was designed to raise chinchillas inside, on both levels. The front has extensive windows, for human comfort and interest. Raising chinchillas requires controlled lighting and ventilation, so the only windows were in the front. The upstairs loft door has a metal arm above it, and was set up with a pulley system, to raise heavy objects (bags of feed and pine shavings) to the second floor without hauling them up the stairs. For ventilation, we installed an industrial fan in the front of the barn above the second floor, and cut holes in the floor at the rear, to force airflow from the front windows, through the building, and out the top at the front. (We also tried a way to pre-condition air coming into the barn when the windows were closed due to cold. We dug a trench about two feet deep and laid a big (12-inch or so) conduit that began several feet east of the barn and ran west across the front wall, turning north just before the barn doors where the conduit turned upward through a hole in the floor. The hole in the floor was covered by a metal box, open on the north side of the box, to keep debris out of the hole and avoid people falling into it. The hope was that by bringing the air through the ground for a run of about 50 feet would warm up the air somewhat before it entered the barn. Now, better understanding true groundsource heating techniques, I realize why this never did work very well. But the conduit and the metal box are still there, so that’s the explanation.)

**Water supply and drainage.** Given the natural spring nearby and the amount of groundwater, we were very careful to put drainage pipes all around and under both buildings, to ensure no water pressure would crack or shift the foundations. In 2017 we added an additional drainage pipe along the east side of the barn, about four feet from the barn, to ensure no water collected near the barn doors.

We lived in the barn for 18 months before the house was built, so all the utilities were initially connected to the barn. Two large concrete cisterns were installed under the concrete barn floor before the floor was poured, for water storage. The spring behind the barn was dug out and a concrete ring installed to centralize water collection at the spring, and a pipe was run from the lower middle part of the concrete ring underground to one of the cisterns. A submersible water pump was inside the cistern, which pumped water out the top of the cistern, through piping in a north-south trench in the floor to a pressure tank which pressurized the water for household use. From the pressure tank, we ran water lines to the stainless steel sink at the front of the barn, to a toilet under the stairway, and to overhead water lines all through the first floor of the barn to service the chinchilla cages.

After nine years, the family had grown and the spring was no longer providing enough water. We had a well dug, 240 ft, pumping over 8 gallons per minute. I had it checked in September 2017, and it is still pumping over 8 gallons per minute. For the next 20 years or more, we ran a hose from the water hydrant into the top of the cistern in the barn to periodically fill up the cistern, with a float, shut-off valve, and overflow pipe. When the house was built, we dug a trench from the front of the barn to the side of the house, and installed a large (4-in?) PVC pipe through which we extended electrical, propane, and water lines from the barn to the house.

We had problems with the water system freezing at various points, especially when we discontinued the chinchilla raising operation and stopped heating the barn with the propane wall heater. Finally, in October 2017, I had the water system completely redesigned and rebuilt. The top of the well was excavated and brought up to code and a new water pump was installed in the well. I had a new water hydrant installed so that water could still be conveyed through a hose to the cistern in the barn, so there would still be water available in the barn, assuming someone solves the winter freezing problem. The crew excavated a six-foot trench from the well to the basement wall, and punched a new hole through the wall to install a water line directly from the pump in the well to a new pressure tank in the basement. This new system is totally freeze-proof.

We always kept one of the cisterns full (using the hose from the hydrant) for fire suppression. A large (3-in?) water line lays near the cistern in the barn, goes through the barn wall, and extends outside, that can be hooked to a portable gasoline-powered water pump, kept in the barn, that has long lengths of water line for firefighting.

**House design.** The house design worked as well as we had hoped. The open kitchen and great room allowed us to have space to spread out, and space for gatherings. The open-beam ceiling was expansive and warm. The wrap-around windows allowed us to connect to the outside no matter where we looked. The TV room, with its separate section for our office area, was separated by doors from the great room, leaving the living and dining areas quiet for conversation. We valued quiet in our home, to the point that we put rigid insulation panels in all the interior walls, as a sound barrier. The guest room on the first floor allowed a guest (like my elderly parents) to have easy access from the outside, and access to the full bathroom and nearby kitchen. The kitchen was spacious and open with lots of windows, lots of cabinets, and lots of counter space. The side entry (mud room) made it easy to bring in wood and groceries. The interior wood bin holds enough wood for cold spells without going out in the snow. The five bedrooms are all large, and we often enjoyed sitting on the balcony off the master bedroom, looking into the woods and sometimes slipping quietly away into the trees.

My husband loved ponds and running water. So, he built a pond into the entry, and a pond in the southwest corner of the great room, both with plants and koi. After we moved out, our son didn't have the patience to maintain the ponds, and so they fell into disrepair. He removed the upstairs pond first, and replaced the pond with a tile floor section. Later the downstairs pond liner began to leak, so that was stopped as well, and filled in with dirt and attractive gravel. But we left the stack of native rock that we had fashioned into a waterfall, in case a future owner wanted to put in a pond of some type again.

We also installed fire sprinklers on a PVC piping system, in the ceilings above the garage and above the living level. But quite honestly, we didn't really use it, and I don't know if it would pass any inspections today. Instead we used smoke and CO detectors.

**Energy saving design.** The house was designed for passive solar heat, with east/west windows for ventilation in warmer weather. The entry roof was originally plexiglass clear panels, allowing light to warm the original pond, the dark tile floor, and the massive native rock wall built by my husband and my father from rock on the property. (Over time the plexiglass panels cracked and leaked, so finally we had to give up and build a conventional roof instead.) The front overhang and the high windows in the great room were designed to maximum penetration of light and the warmth of Colorado's warm winter sun all the way back to the bathroom, but minimize heat in the summer. The many windows, and stairway skylight, allowed daylighting throughout the house in all the south-side rooms, saving electricity. North-side windows were kept to a minimum, but we did include one in each bedroom and on the landing because the view to the north through the aspens was so beautiful. We put in two hot water heaters, one in the utility room near the main plumbing wall that services the three bathrooms and laundry room (propane), and one under the kitchen (electric). Our rationale for two hot water heaters was to avoid wasting a lot of water due to the long run from the utility room, whenever we needed warm water in the kitchen.

**Energy saving building envelope.** Originally the house had cedar siding, like the barn. The attic had a foot of blown cellulose, I think, although I haven't checked it in a while. The great room windows consisted of single-pane windows and an internal second pane made of Plexiglas and sealed against grooves with foam insulation strips, to give a 4-inch dead space. All the rest of the windows were commercial wood frame made by Weathershield. After nearly 30 years, the windows, siding, roof, garage doors, and the rest of the doors all needed replacement. All these components (except the master bedroom balcony door) were replaced and upgraded in 2014-2016.

As an employee of the National Renewable Energy Laboratory for 26 years, I chose replacement components for the building envelope to maximize energy efficiency. The replacement roof (2014) is metal, to minimize forest fire danger. The windows (2016) are from Sunrise, and were chosen to optimize transmittance and U-value, with different coatings for different windows, depending on location and functionality. The new garage doors (2015) are insulated. The James Hardie siding itself (2016) has significant insulative characteristics, but I also had an extra thermal barrier installed. The installation of the siding and windows (K&H Home Solutions, Arvada) was excellent, with everything possible caulked and tight. The steel front door, fiberglass side door, and sliding glass patio door (replacing a drafty French door, all in 2016) were also chosen for energy savings. The house is "snug as a bug in a rug." A summary of the specific R values of everything is available.

**Heating system.** The main source of heat has always been the large wood stove, replaced a couple times over the years. We were always careful to clean the chimney each year. (Best way to use it – Open the door and the damper, and check the thermostat to set to three. Build the fire and keep an eye

on it while it gets going and builds up some coals. When the fire is well established, close the door and damper. Leave the thermostat on three all the time. Add wood as needed. Clean out ashes periodically. Have someone clean out the chimney once a year. Use the ceiling fan, and/or the noisier fan built into the stove itself, to help distribute the heat.) The three bedrooms on the south side benefitted from fans carrying warm air from the ceiling of the open-beam ceiling of the great room. A hotwater baseboard system originally provided heat for the rooms on the north side far from the stove, on both levels. Over the years the hotwater baseboard system had some problems, and in 2017 a new electric baseboard system was installed throughout the house so it was not so dependent on wood heat. The electric heater in the great room has bricks for mass to store heat generated during off-peak hours. The energy management system (ie, the control box) ensures that all the electric baseboard heaters (and electric water heater) operate only during off-peak hours and sustain a comfortable temperature all day and night with minimal cost. There is a manual override if more heat is needed during peak hours. Ed Maycumber of United Power was my consultant for this new system.

**Solar electric system design.** We came very close to installing a 7.4 kw solar system from Solar City on the east-facing roof of the barn. This location was chosen because the house has the wrong kind of metal roof and it won't work to attach the panels, and the west side of barn roof has too much shade. Design and other info is available if someone wants to pursue it.

**Fencing and chicken coop.** Because my husband and I, and later one of my sons, raised animals on the property, there is still some fencing in place. The most obvious is a long electric fence that my son installed, encompassing the building site and the lower acreage. The control box is due east of the barn, in a line with the front wall of the barn, on a rock. It is not plugged in as of September 2017. There are two physical openings in the electric fence that allow a person to pass through to the higher elevations on the property. One is directly north of the barn, and one is northwest of the house. Also, there is still a functional chicken coop tucked in back of the barn.