

Building an off-grid, passive and PV solar, sustainable home in Rio Rancho, NM

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Purpose of talk

- To describe the history of the successful construction of an off-grid PV-solar “sustainable” home
- To describe the 1st year performance of the energy and water usage and lifestyle adaptations
- Suggest changes in Rio Rancho tax/inspection regulation that would promote solar construction
- Give pointers to the prospective owner/builder



History Prior to Project Initiation

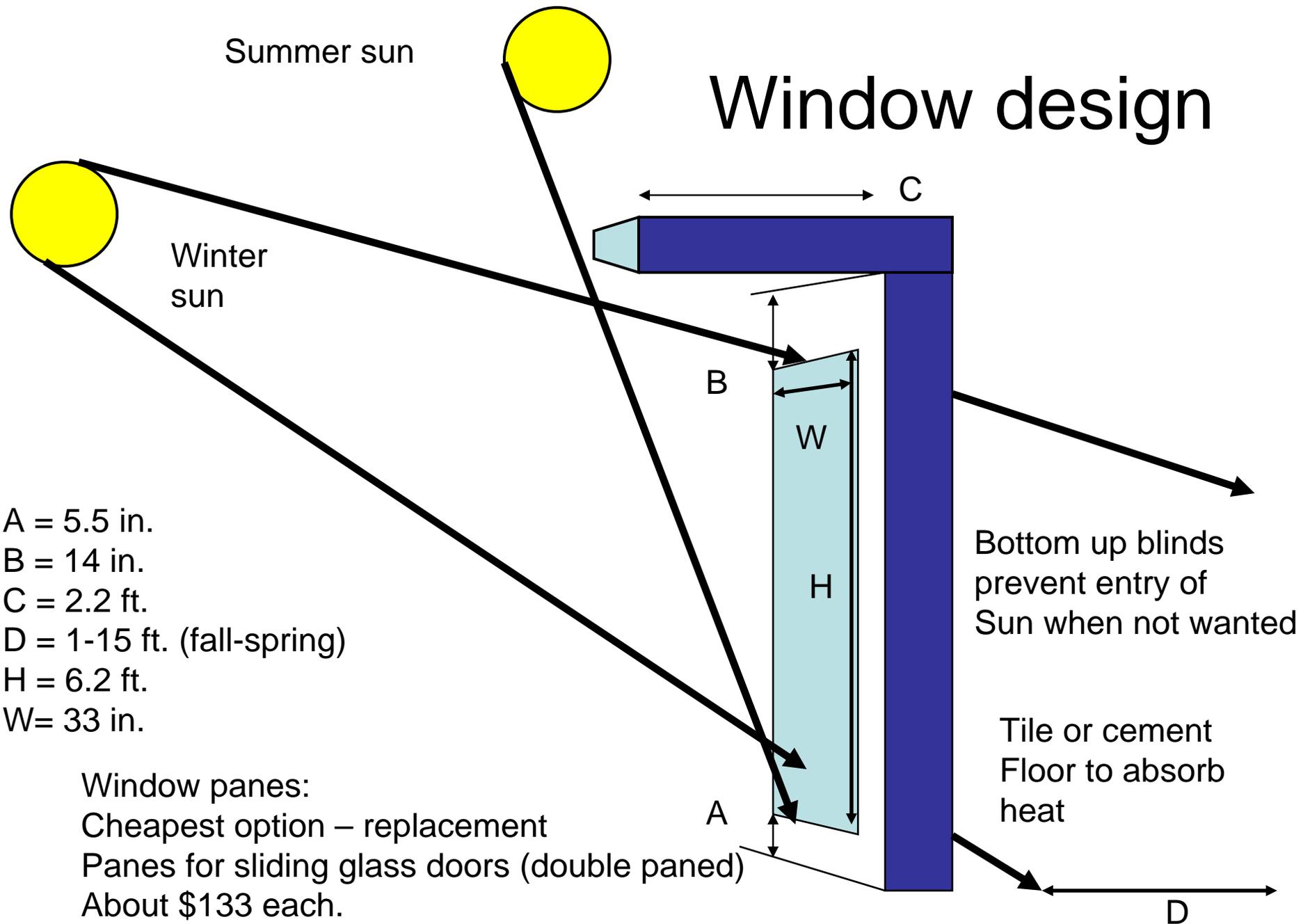
- 2 Lots purchased in December, 2001
- Water and electric/gas about 1 block from lots
- Original plan to build a passive solar on-grid home upon return from overseas LOA
- Returned in Feb. 2005, water still 1 block from house; electric/gas ½ block.
- Estimated hookup: \$15,000 electric/gas, \$54,000 water + impact fees; also \$25,000 water well
- High fees motivated off-grid PV solar home with temporary cistern system for later hook-up of city water

Passive Design Aspects

- Passive design aspects
 - Long south facing home (60 ft x 28 ft) to maximize south window area and exposure, overhanging roof to shade south windows in summer, honeycomb (some bottom-up) blinds
 - Heavily insulated: R-38 ceilings, R23 walls, 10 inch S wall R-30, R-19 interior 2x6 walls and R38+double wall on North side (to accommodate electrical/plumbing lines)
 - Unheated (by radiant heating) mud/pantry room at front door moderates temperature in great room
 - Interior walls insulated to separate living spaces/rooms, unheated areas when not in use
 - Sloped roof for rainwater collection
 - Greywater gravity drains for garden areas
 - Woodburning stove



Window design



A = 5.5 in.

B = 14 in.

C = 2.2 ft.

D = 1-15 ft. (fall-spring)

H = 6.2 ft.

W = 33 in.

Window panes:

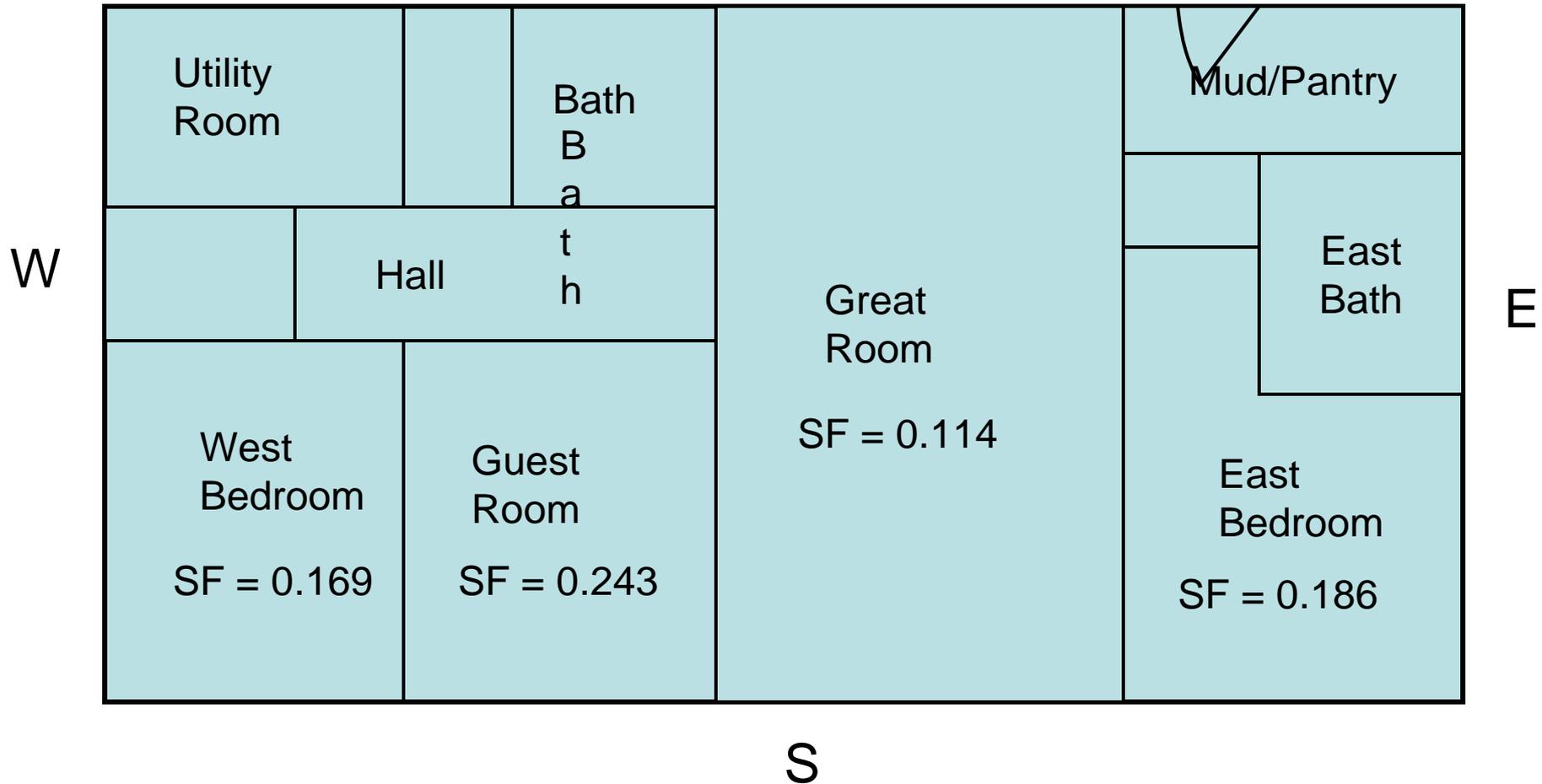
Cheapest option – replacement

Panels for sliding glass doors (double paned)

About \$133 each.

House Plan – 1680 sq. ft.

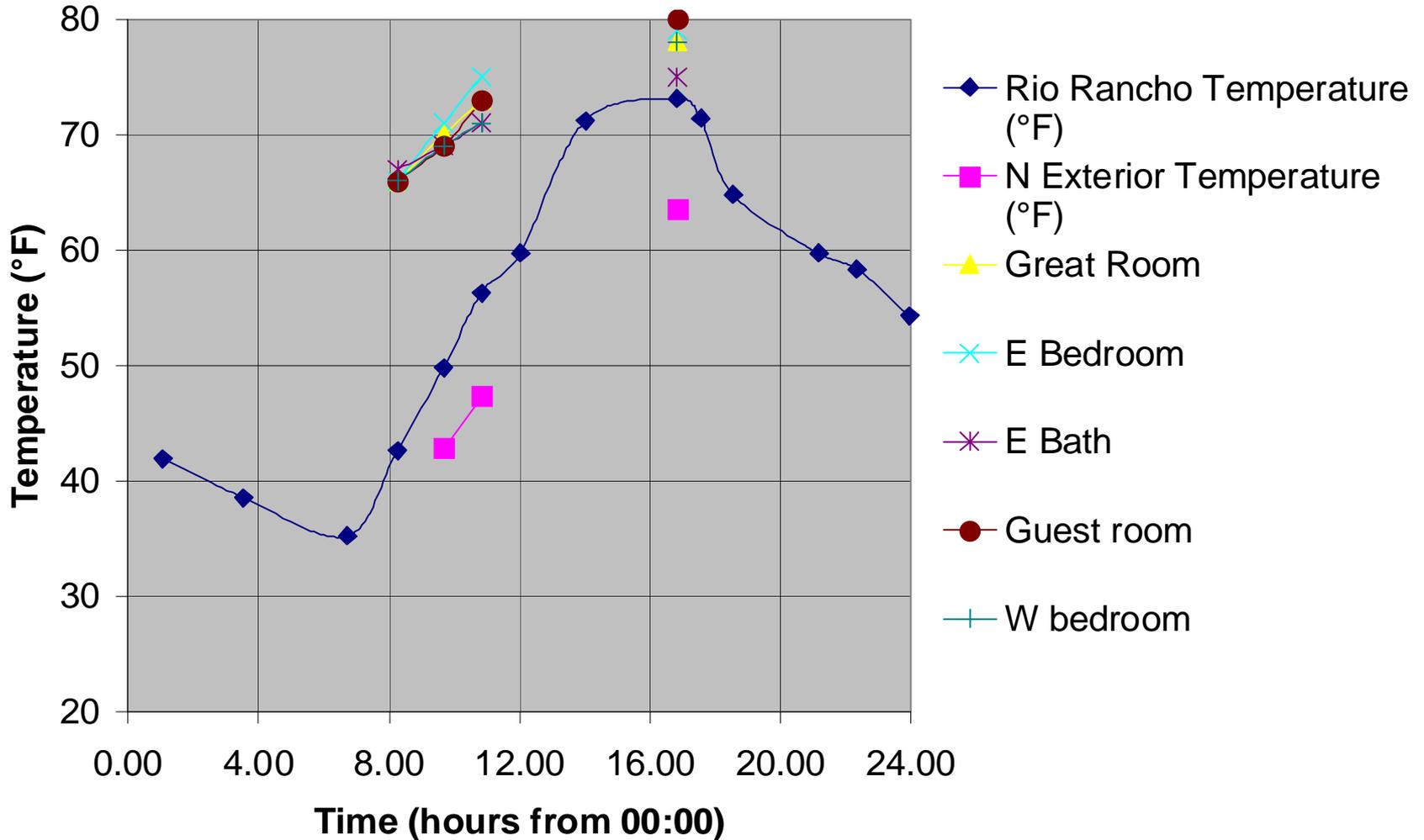
$$SF = \frac{\text{Area of South Windows}}{\text{Room Area}}$$



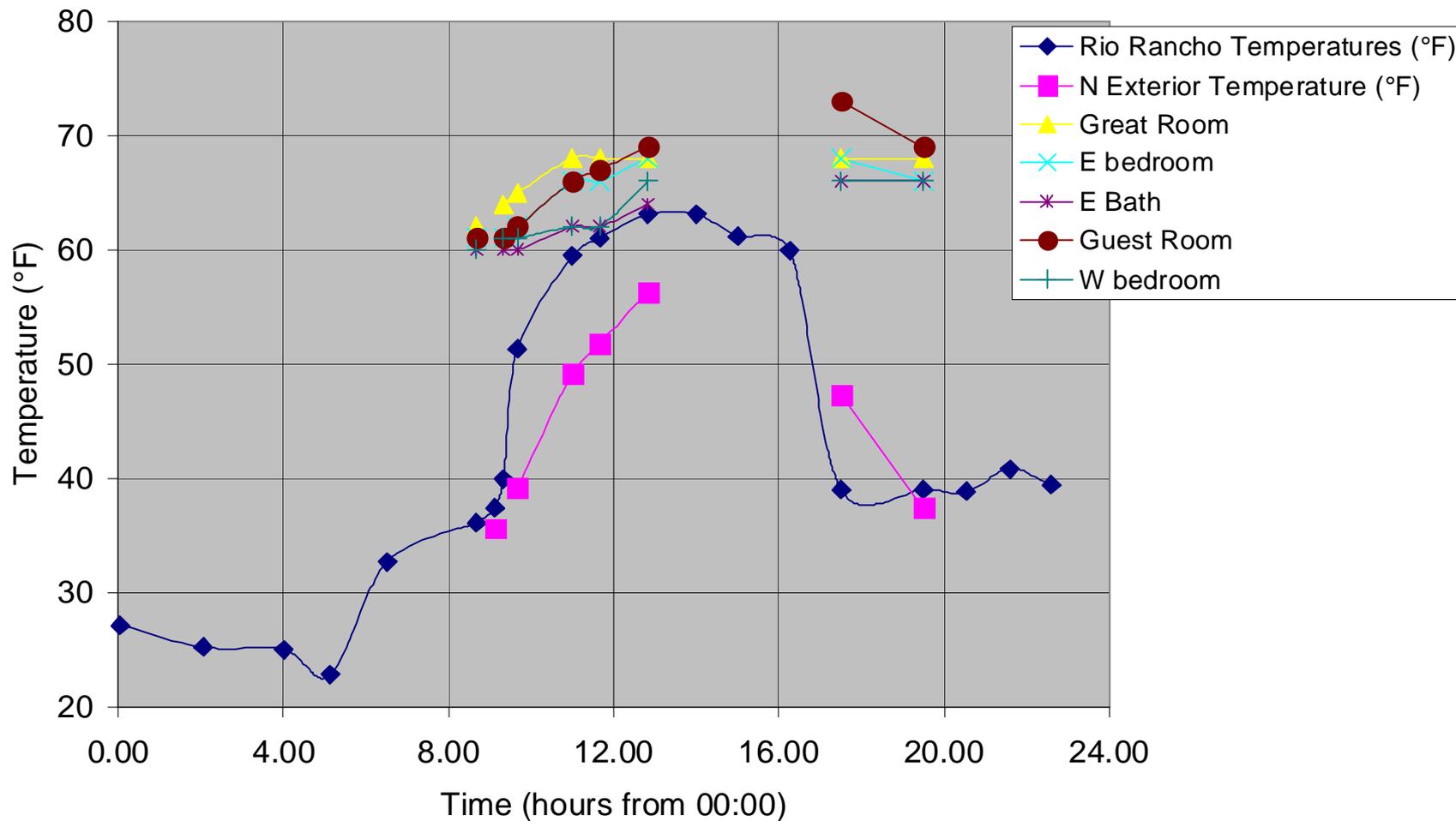
South side – recent photo



Room Temperatures (°F) 3/01/08 sunny day



Room Temperatures (°F) 3/08/08 cloudy am, hazy sun pm
 wood stove 8:30 - 10 am; GR and bed doors closed; W Bed blinds closed until 11:45;
 Guest blinds open, others 1/2 open am



PV Solar Design

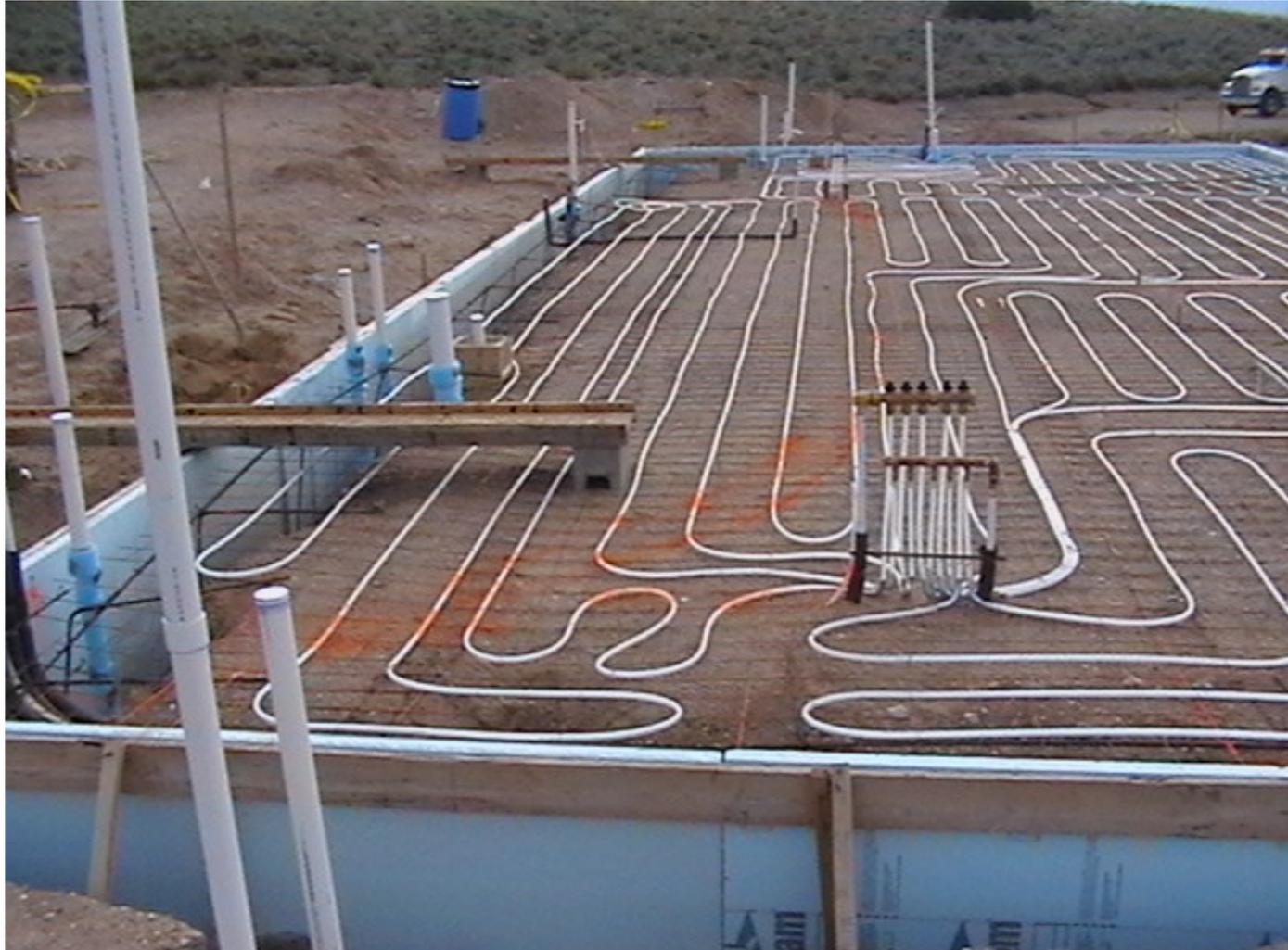
- 12 165 W Mitsubishi solar panels (2 KW system)
- UniRac tilt-adjustable solar mount
- 48 V DC system (8 Rolls S530 400 AH solar batteries)
- Outback GVFX3548 grid-tie inverter
- Outback MX-60 MPPT charge controller
- Son (electrician) installed electrical.
- Small gasoline electric generator for back-up (used in house construction)
- Major loads on system
 - Grundig water pump
 - 18 cu. ft. Kenmore refrigerator (energy saving)
 - Microwave, toaster oven, 500/1000 W space heater, toaster, swamp cooler (summer)



Other Design features

- Six inch slab radiant heating with propane furnace (85% efficient)
- Mastercool swamp cooler
- Standard 40 gallon hot water heater
- Potable water in 1600 gallon water tank with Grundig electric pump (\$185 per 1800 gallon delivery)
- Septic tank
- Off-grid construction required 2 generators and a 200 gallon water tank (now used for harvesting)
- Recently purchased 305 and 550 gallon water tanks

Radiant heating



Planning stage

Problems/Worries

- Off-grid cistern not an option for house plans, paid for well permit and included well on plans
- Radiant heating worries (tubing depth, interior wall nails, slab cracks, expensive bubble wrap under slab?)
- Underground A/C plastic duct? - Not code in Rio Rancho but is code in Santa Fe
- Unaware of codes and rules; had lot leveled w/o grading permit
- Difficulty in getting bids or high bids if job not wanted
- Accident/vandalism insurance



Reducing energy dependence while living a reasonable life style

- Hauled water and propane are more expensive than city provided water and natural gas
- Leverage electricity and wood stove
 - Wood stove cooking/toaster oven cooking when sunny
 - Sparse use of radiant heating
 - Timed use of appliances
 - Use scrap lumber in wood stove
 - Water heater jacket, put on pilot setting between showers
- Water conservation measures
 - Drip irrigation/grey water garden
 - Short showers & less frequent toilet flushes
 - Use of laundromat when shopping
 - Use of rainwater for flushing, washing, watering, etc.
- Not everyone adjusts equally

Water/fuel usage first year

- Propane = 185 gallons @ \$2/gallon=\$370
- Water = \$730 (hailed) + \$65 (drinking) + harvested: approx. 9.2 in. x 1680 ft² = 9600 gallons (75% (?) collected).
- Electric = \$200-\$400 (battery depreciation) + \$300 (panel depreciation) + \$200 (other equipment)
- Wood (1 pickup load) = \$100 (actually \$0 since waste)
- Future construction to more than double roof collection area: 550 gallon pre-tank gravity-feed to main water tank
- Also planned: conversion of propane radiant heating to solar, solar hot water

Changes to promote sustainable construction

- Prospective home buyers need to ask for passive solar from realtors/builders
- Reduce impact fees for sustainable homes
- No gross receipts tax for solar/passive windows and renewable/green construction materials
- City sponsored (cheap) night courses for electricians to obtain solar install qualification
- Laws to require information for new homes similar to that of an energy star appliance
- Mimic Germany
- The energy (natural gas) that we save by using passive solar in homes could be used to power vehicles