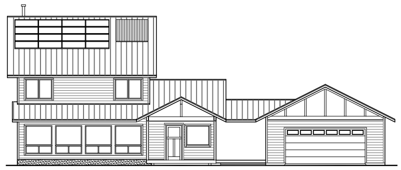
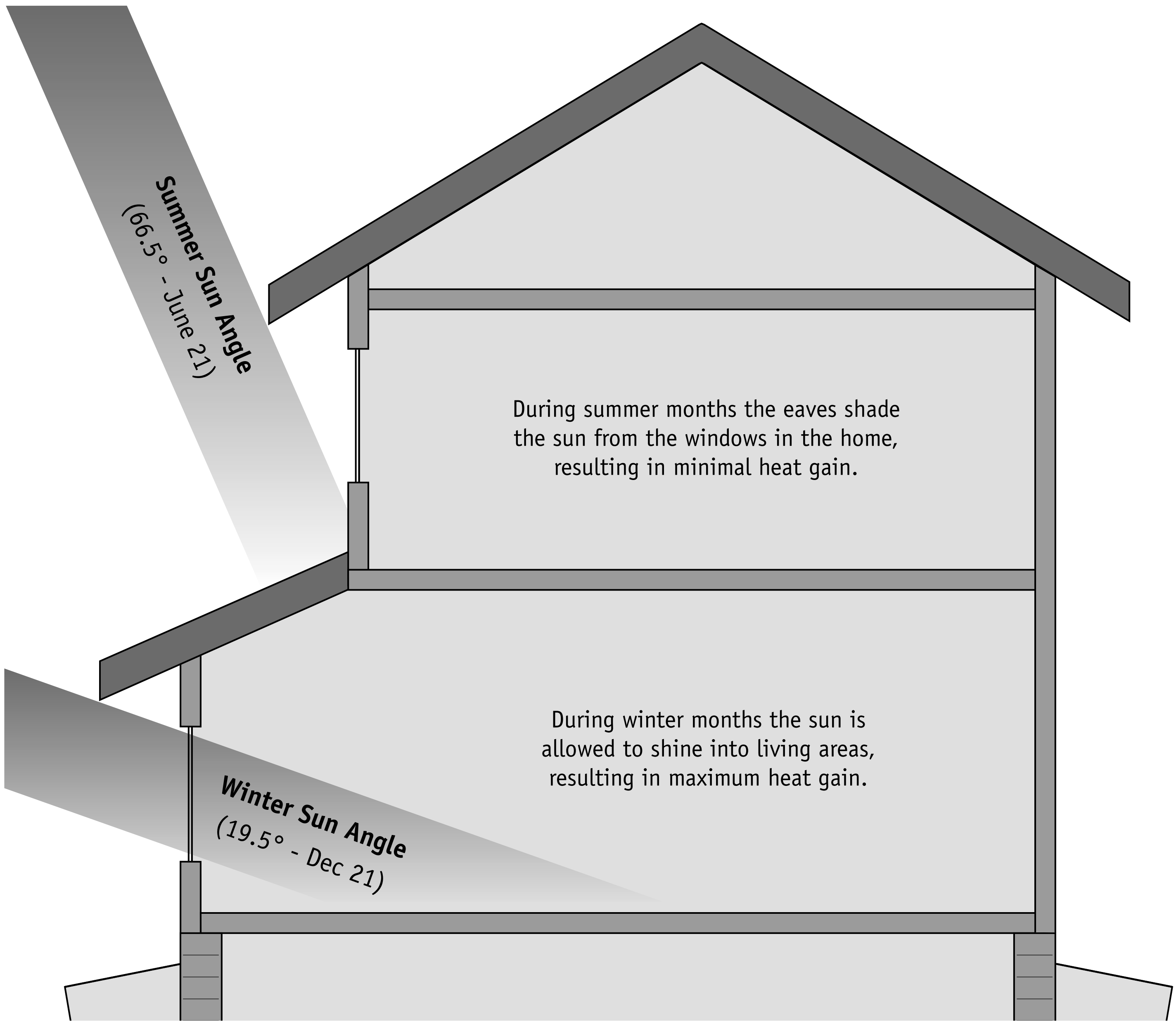
Eco-Home
at Hawk Ridge



A solar model demonstrating energy efficiency, renewable energy and green building

Schematic Diagram : Passive Solar Design



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Passive Solar Design & the Building Envelope

A Few General Rules for Passive Solar Design in a Cold Northern Climate

- Orient the building and interior space plan for daylight and direct solar gain with major glazed areas within 30 degrees of south
- Design a compact building form without too many corners
- Use the solar altitudes (based on latitude) at the summer and winter solstices to size windows and overhangs that allow direct heat gain in winter and block direct solar gain in summer (www.mnpower.com/energyhome/docs/solar.pdf)
- Determine the optimal sizing, layout, and type of windows and shading devices to allow solar gain but also offer protection from overheating
- Select glazing that allows solar heat gain (with a high solar heat gain coefficient) but also maintains thermal performance (with a low U-value)

Passive Solar Design of the Eco-Home

- The building form and orientation on the site allow about 6 hours per day of unobstructed solar gain in winter months
- Open living, dining, and kitchen spaces face south, so that maximum solar gain and comfort occurs in the most frequently occupied areas
- Insulated slab-on-grade design allows the first floor slab to store solar gain in daytime and release it back into the house at night
- The majority of windows (58%) face south and all south-facing windows have roof overhangs sized to allow winter sun in and keep summer sun out
- The ratio of south glazing to floor area is 12%, which helps avoid overheating

A High Performance Building Envelope Ensures Successful Passive Solar Design

- Detailed energy analysis helped guide the choices that maximize winter solar gain without compromising the overall thermal performance of the building
- The three largest contributors to heat loss in the building envelope are the exterior walls, the envelope air tightness, and the windows, so extra attention was paid to the design and selections in these areas
- 9 1/2” thick double stud exterior walls reduce thermal bridging, with dense pack cellulose insulation (R-36)
- Roof trusses have a 16” heel; attic insulation level of R-60 (16” blown cellulose)
- Frost protected slab on grade foundation with 4” XPS (R-20) underslab insulation
- Rim insulation R-31, using Emercore insulated rim board (R-13) and 3” of 2-part urethane foam insulation (R-18) sprayed to the interior of the rim
- Careful air sealing at all seams and building penetrations and continuously sealed interior vapor barrier and air barrier maintain envelope air tightness.

A Window Strategy That Lets the Winter Sun In and Retains the Heat Gained

- All windows have insulated fiberglass frames, triple pane glazing with argon fill, and warm edge spacers (Cardinal XL Edge) www.duxtonwindows.com
- Choices in solar-selective low-e coatings allowed specification of south glazing with a higher SHGC that still retained good overall thermal performance
- South windows have a glazing solar heat gain coefficient (SHGC) of 0.63 and a typical overall U-value of 0.21 (one low-e coating - Cardinal 178)
- North, west, and east windows have a glazing SHGC of 0.41and a typical overall U-value of 0.19 (two low-e coatings - Cardinal 272)

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