Overview
Harmony House Equilibrium Project

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Harmony House Equilibrium [tm] Project

- The Harmony House design is a winning entry in CMHC's national EQuilibrium™ Sustainable Housing Demonstrative Initiative and the only such project on the west coast.

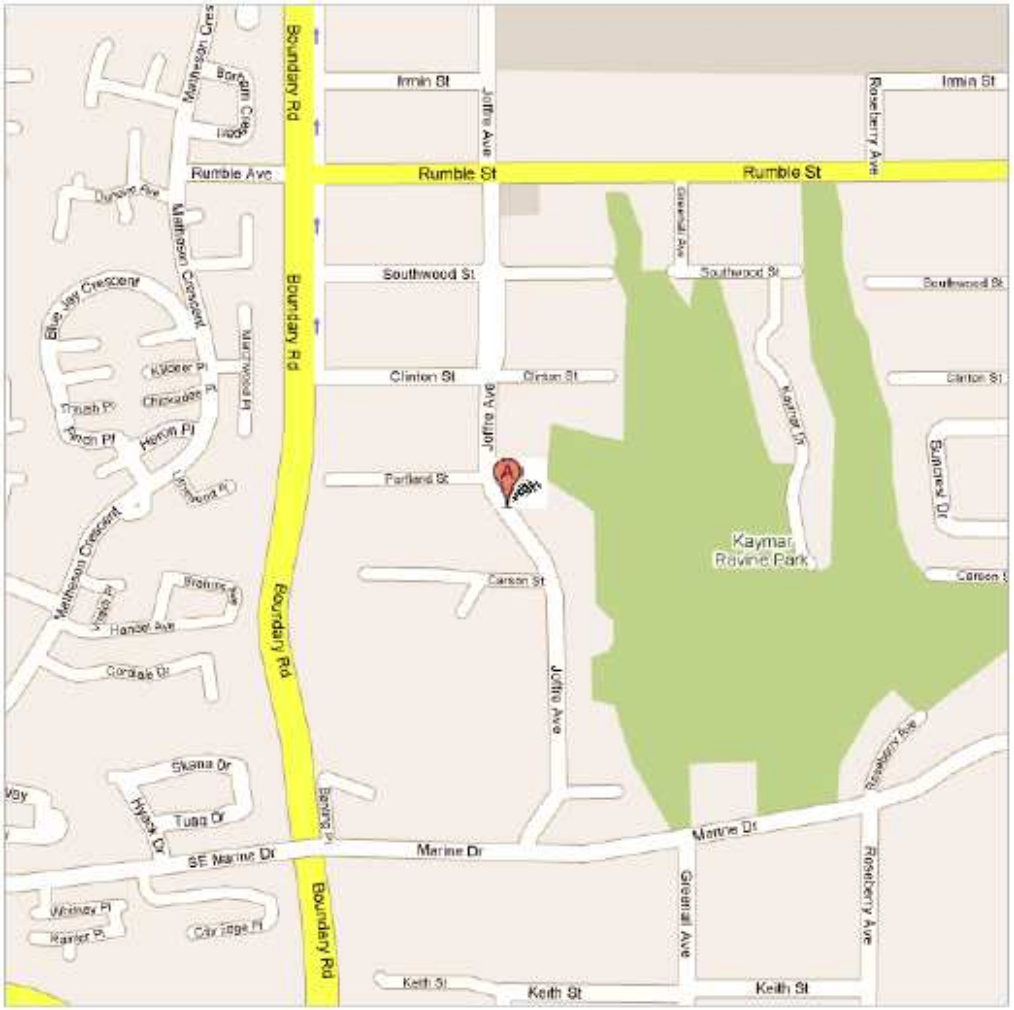
Harmony House Equilibrium [tm] Project

Harmony House will be designed and built to the next generation green building standard with such features as:

- A healthy and comfortable indoor environment
- High levels of energy efficiency
- Low environmental impact
- Significantly reduced water use
- Production of as much energy as it consumes in a year (a net-zero energy home) from on-site renewable energy systems

- Net zero energy (zero carbon) has been set as target for future new buildings by regulatory agencies and professional organizations around the world.

7990 Joffre Ave. Burnaby, B.C.



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7990 Joffre Ave. Burnaby, B.C.

Looking Southeast

Looking Due South

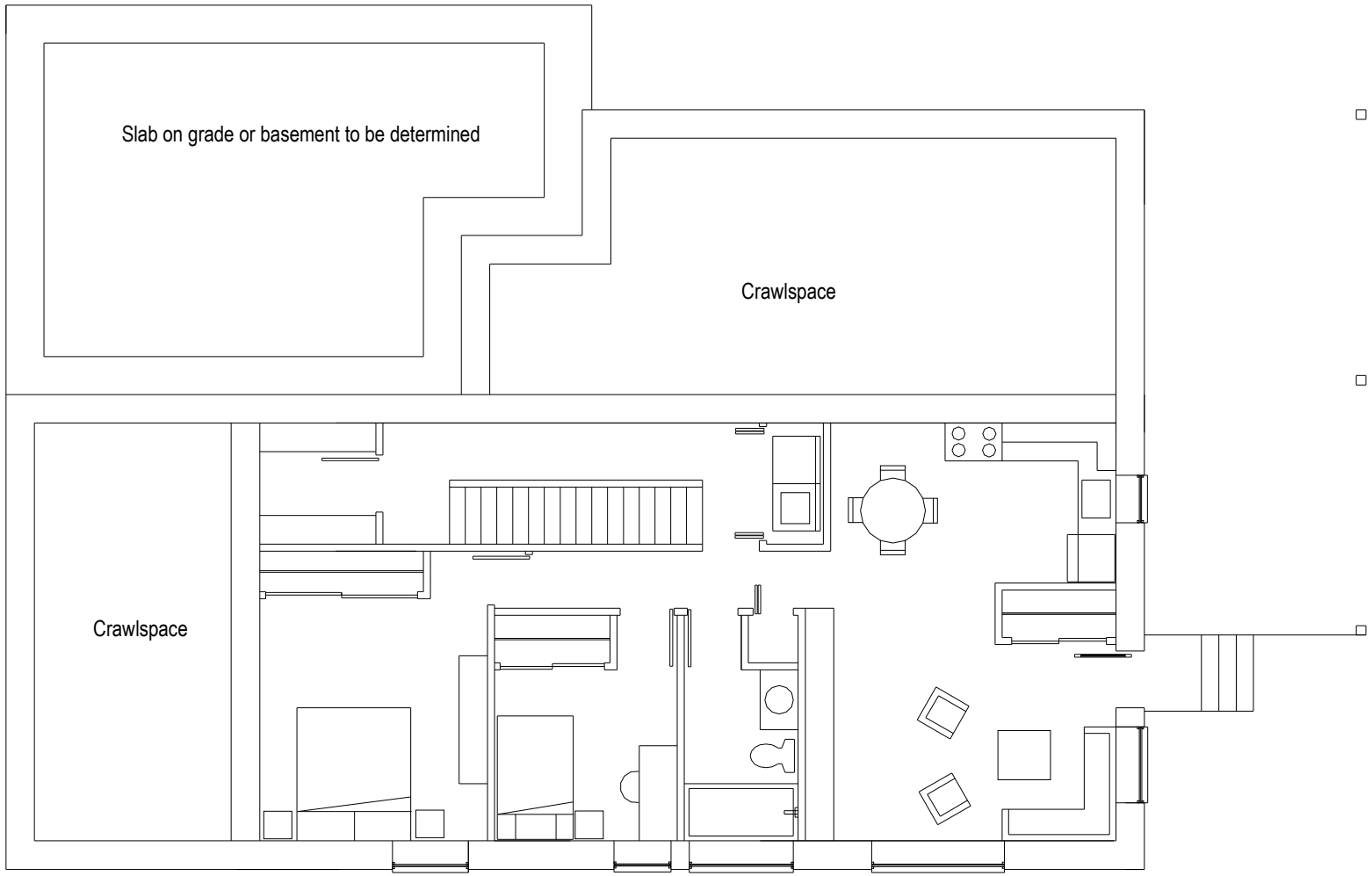
HD+C Ltd. Looking East from Joffre

Looking West towards Joffre

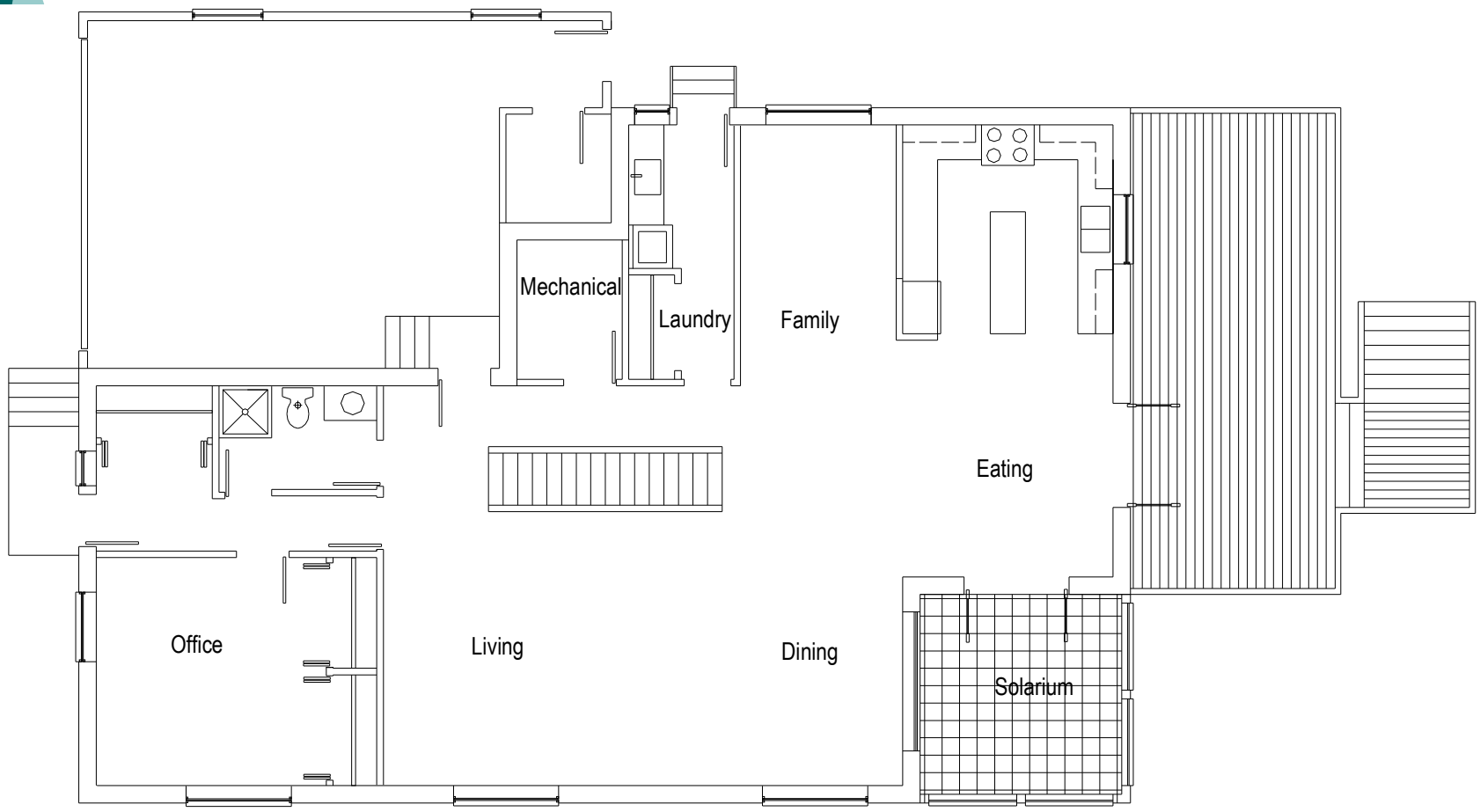
Program

- 3500 sq. ft. two family home
- 3 bedroom
- Office
- Two bedroom in-law suite
- Spatially open
- Healthy indoor environment
- Low environmental impact
- Net Zero Energy (zero carbon) for space heating, water heating and all electrical requirements

Basement

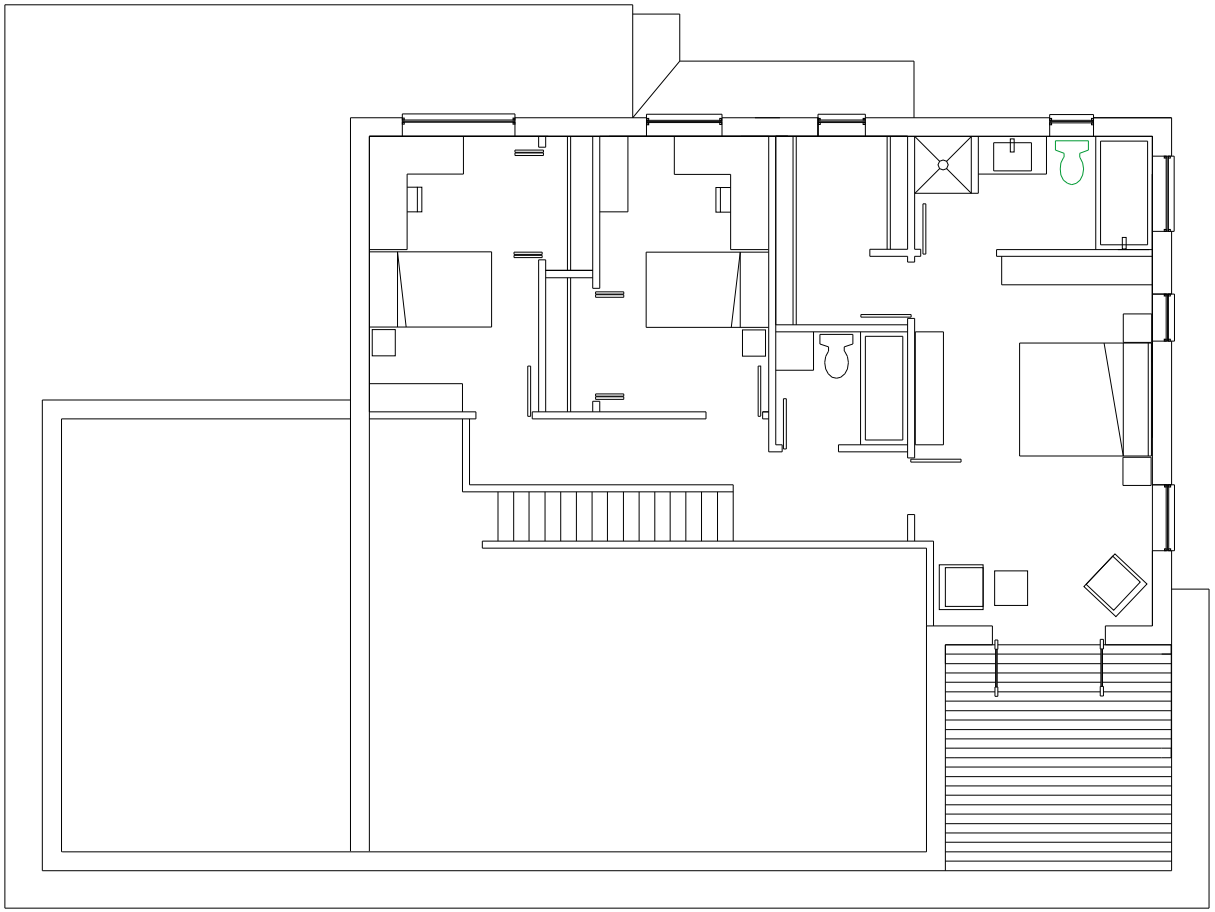

Slab on grade or basement to be determined
Crawlspace
Crawlspace

Main Floor



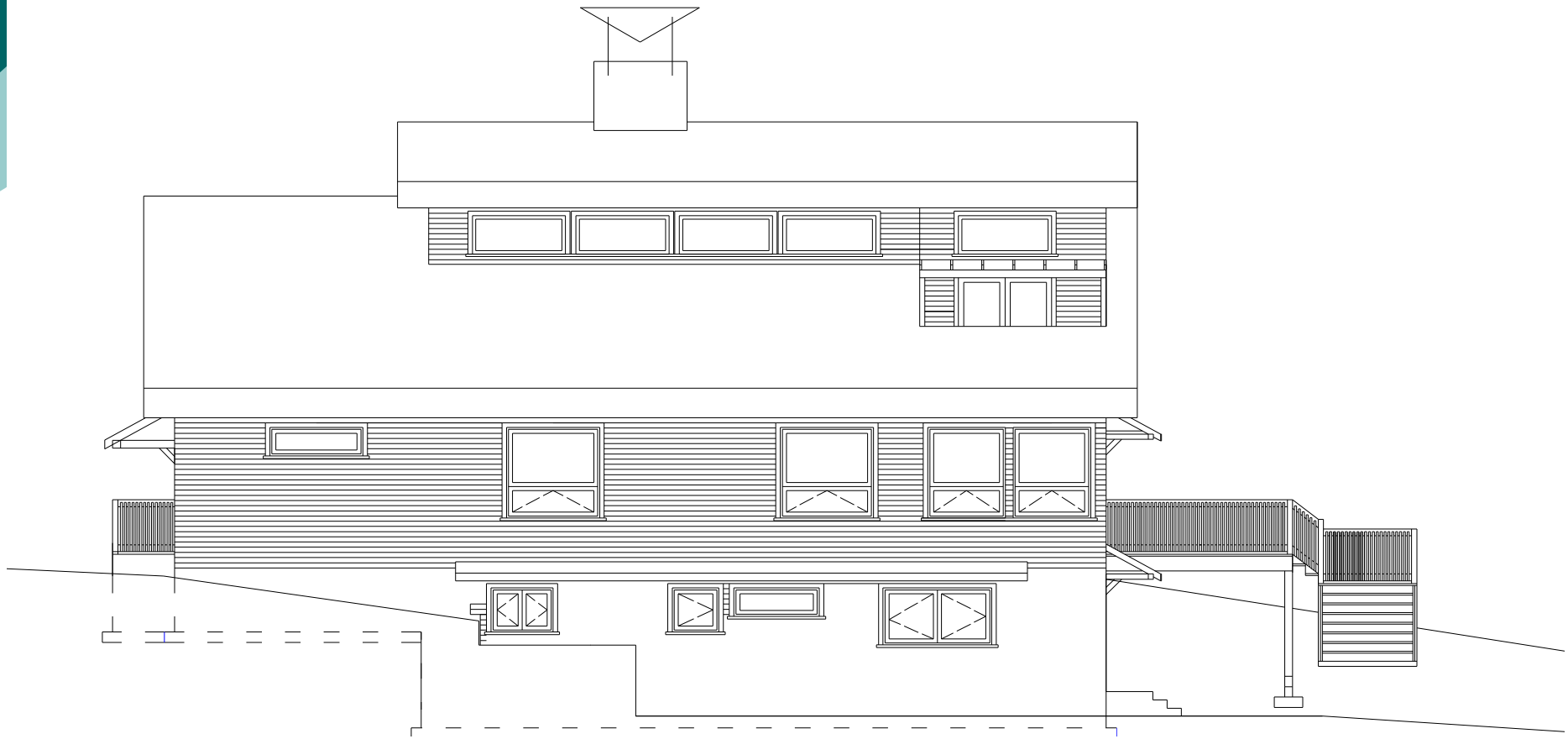
First Floor Plan

Top Floor

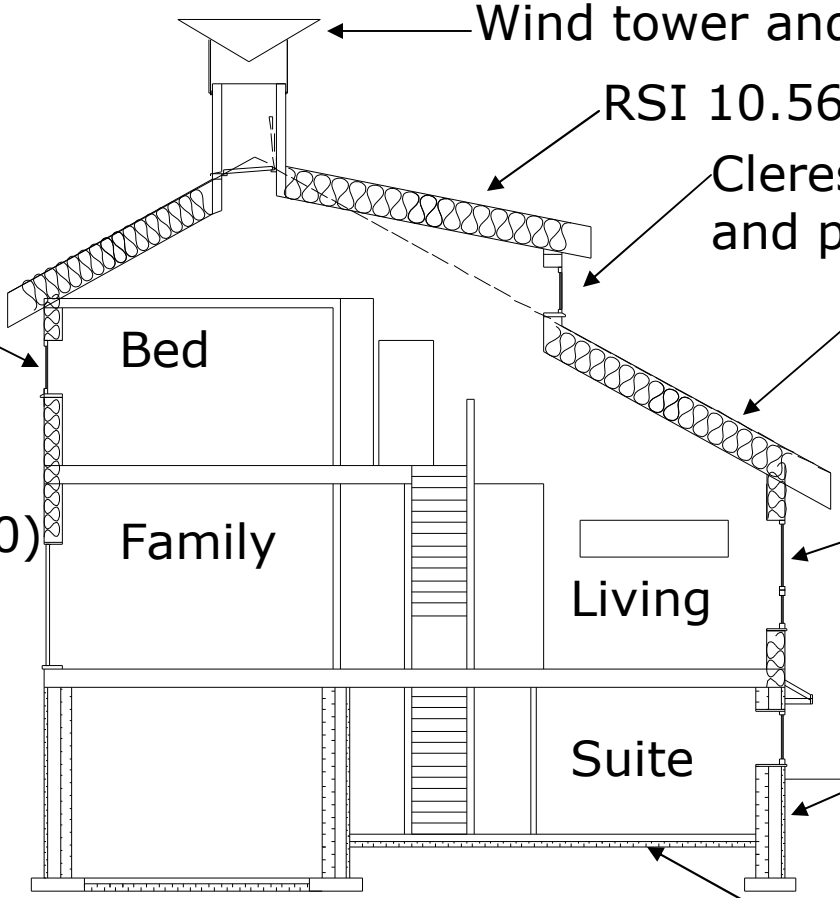


East Elevation

South Elevation



Preliminary Design



Wind tower and skylight with aero cap

RSI 10.56 (R60) roof

Clerestory windows for daylighting and passive solar gain

RSI 1.06
R 6 triple glazed windows

Solar thermal and solar electric (PV) panels

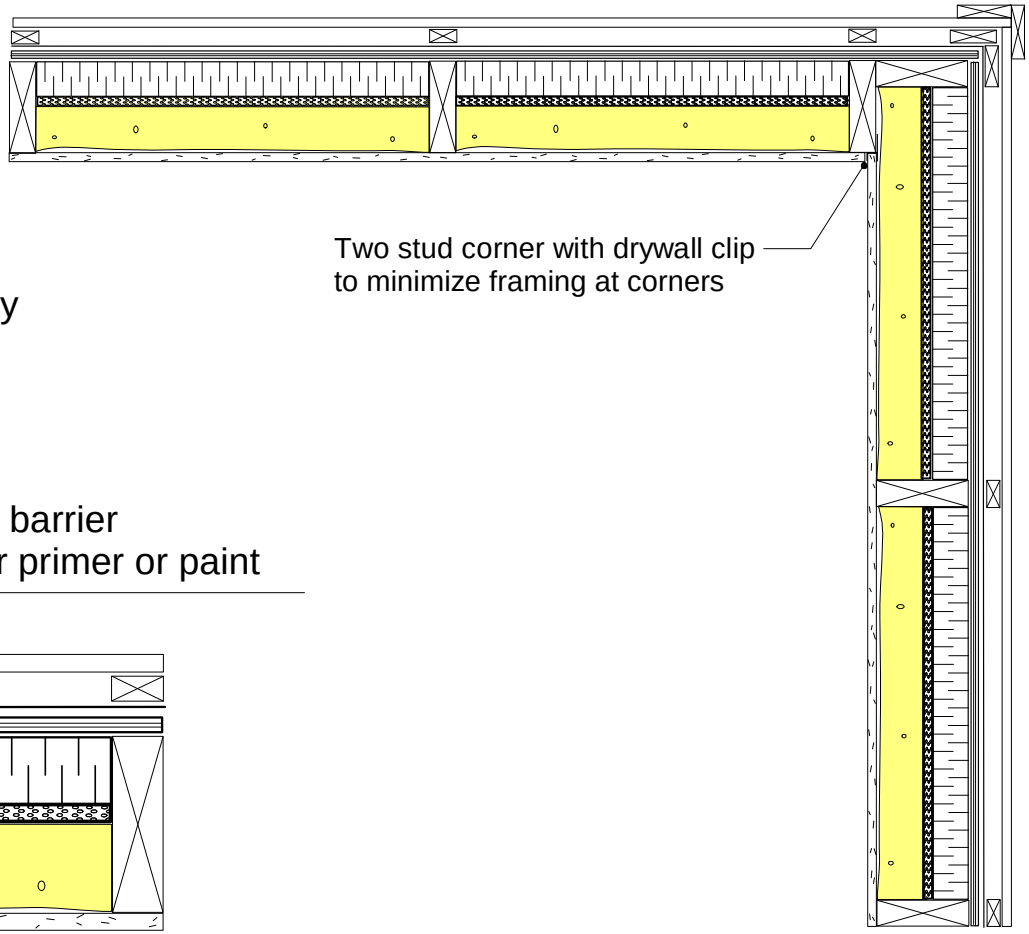
RSI 7 (R40) walls

South facing windows for daylighting and passive solar gain

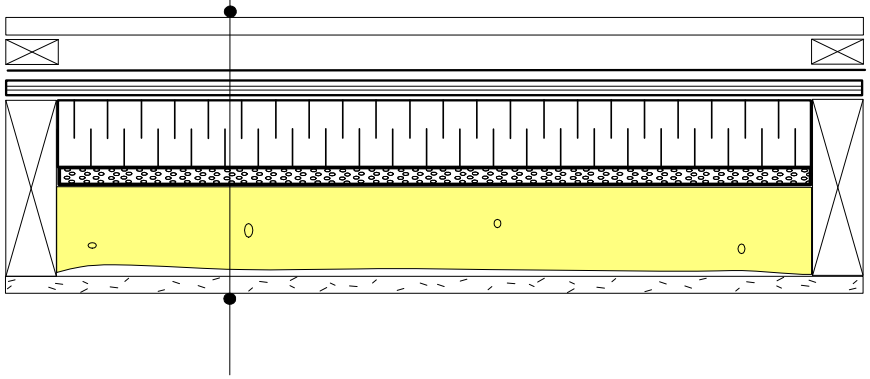
RSI 7 (R40) insulated concrete foundation

RSI 3.5 (R20) under slab insulation

Wall Assembly
RSI 11.9 (R 67.6) Nominal
RSI 6.6 (R 37.7) Composite



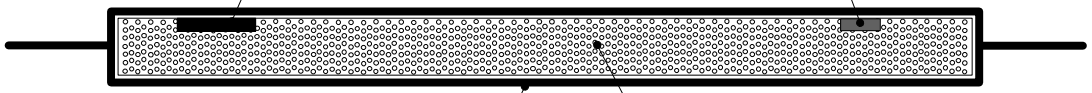
Exterior cladding
Rainscreen drainage cavity
Weather resistant barrier
Structural sheathing
Foam board insulation
Vacuum insulation panel
Spray foam insulation / air barrier
Drywall with vapour barrier primer or paint



Vacuum Insulation Panels

Getter and desiccants to absorb water vapour and gasses that may diffuse through exterior skin and joints over the life of the panel

Proprietary pressure sensor used in some panels to provide quality assurance during manufacturing, shipping, handling and installation

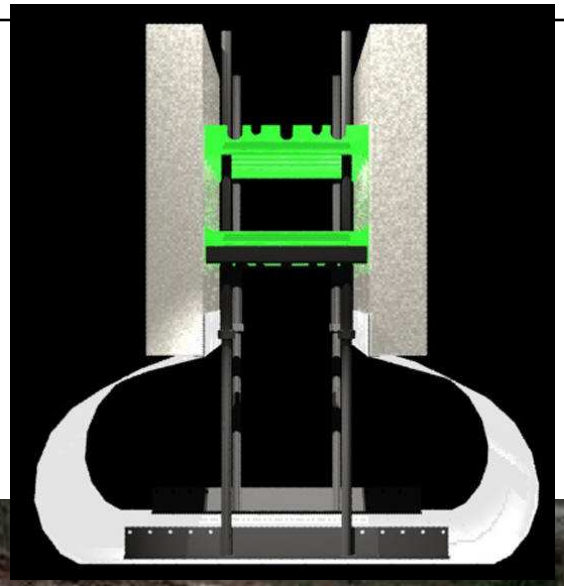


Exterior skin of aluminum foil or plastic / aluminum composite heat sealed or glued at all joints. Flanges maybe folded to allow for butting of panels

Gas porous core of foam, fiberglass board, aerogel or compressed silica with opacifiers initial vacuum less than 5 mbar

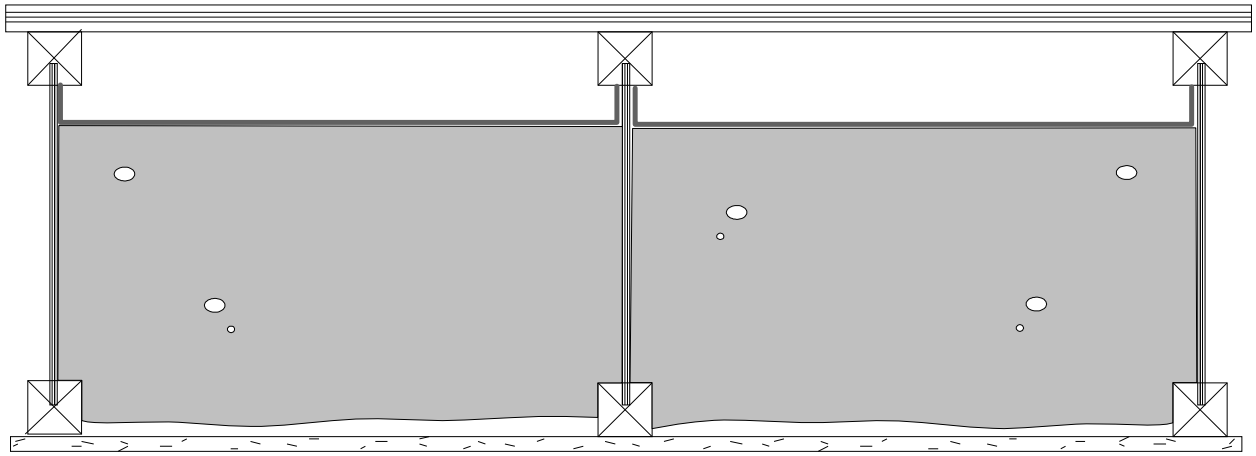
RSI 7 (R40) Basement / Crawlspace Walls

- Fabric footing system minimizes concrete wastage and moisture entry through footings
- ICF blocks provide formwork and stay in place
- RSI 3.5 (R20) non ozone depleting extruded polystyrene foam insulation beneath all basement and crawlspace slabs



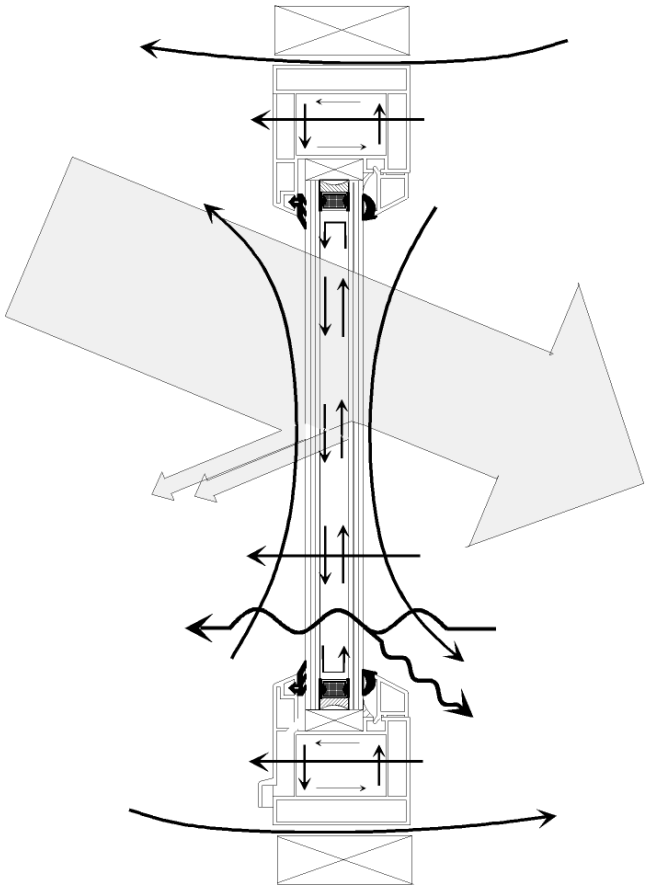
Roof RSI 10.56 (R 60)

- 500mm (20”) deep wood I joists with low density castor oil based spray foam insulation.



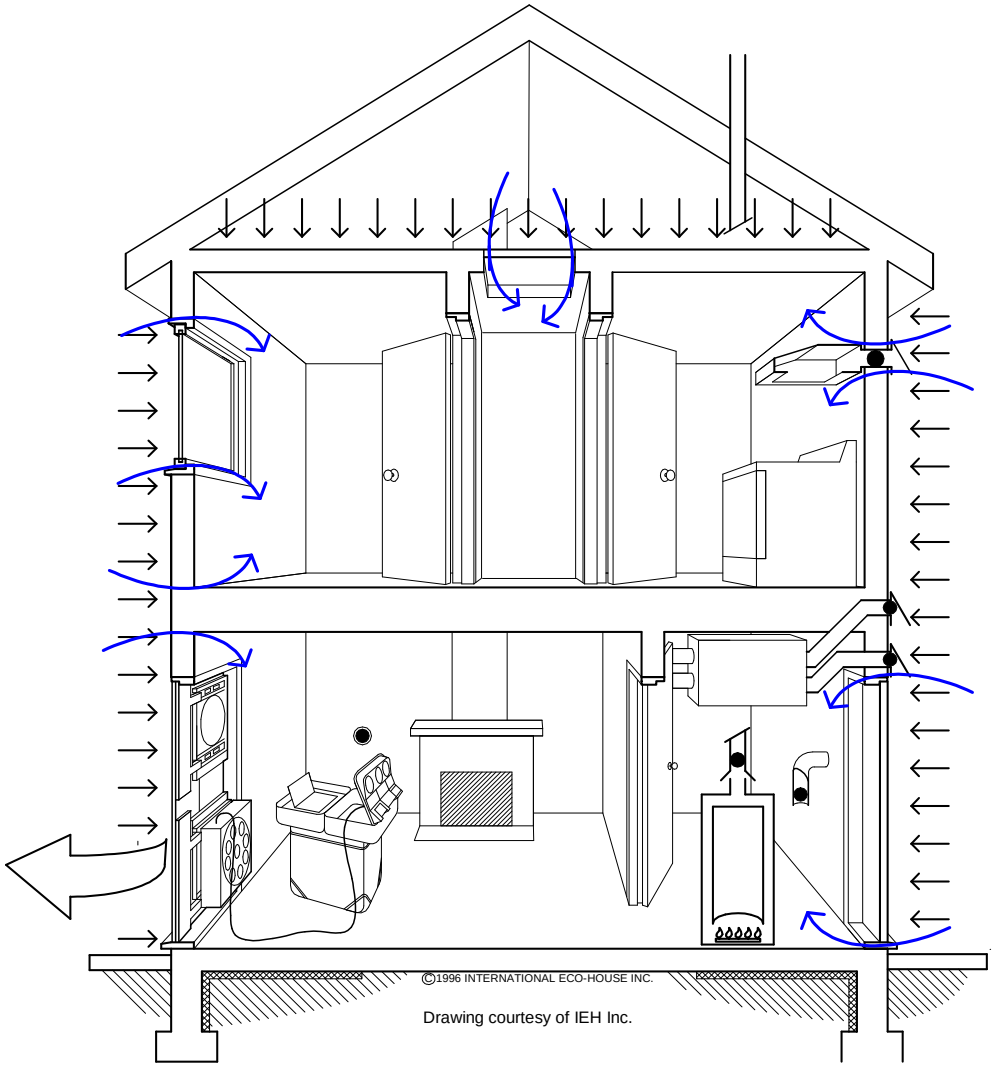
Envelope
Windows

- Triple Glazed
- Double Low E
- Insulated Spacer Bar
- Argon Gas Fill
- Fiberglass Frame
- Casement Opening
- Average R value of 6



Airtightness

- Airtight Drywall Air Barrier
- 0.75 ACH @ 50 Pa



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Electrical Energy Conservation

- Smart Metering
- Appliances
  - Minimum Energy Star or better
  - Green switch
  - Motion detector activated power bars
- Equipment
  - Air handler fan – EC motor
  - HRV DC motors
  - Ductwork oversized to minimize flow resistance
- Lighting
  - Controls to allow daylight harvesting
  - Motion activated light switches
  - High efficacy lighting fixtures
  - Cold cathode fluorescents and LED’s
- Goal 5000 kWhr / yr for lighting and appliances

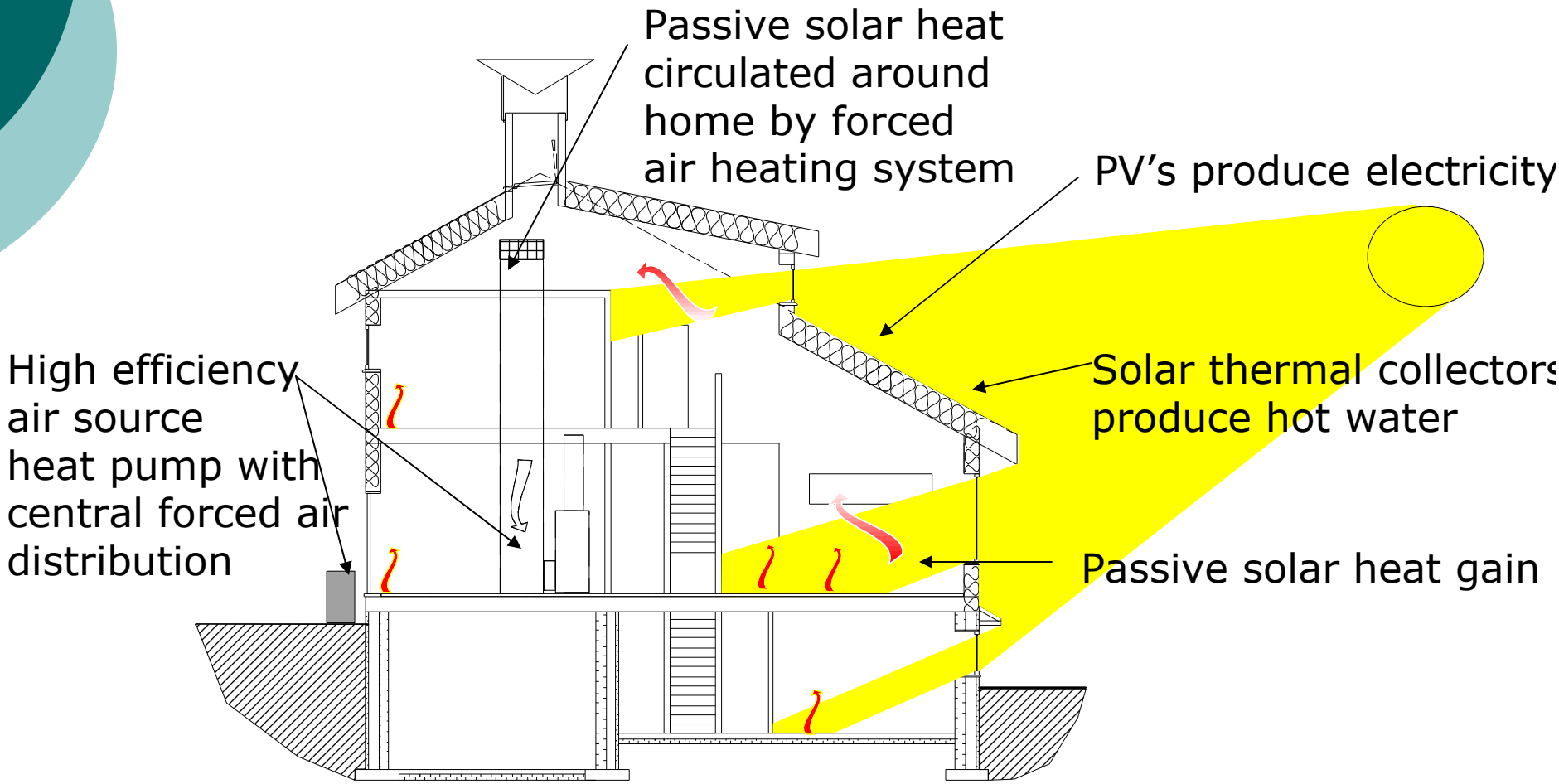
Energy Systems

- Passive solar space heating
- Solar domestic water heating system
- Grid connected PV array
- Wind and stack driven cooling
- High efficiency air source heat pump for space heating
- Ducted central Heat Recovery Ventilator

Passive Solar

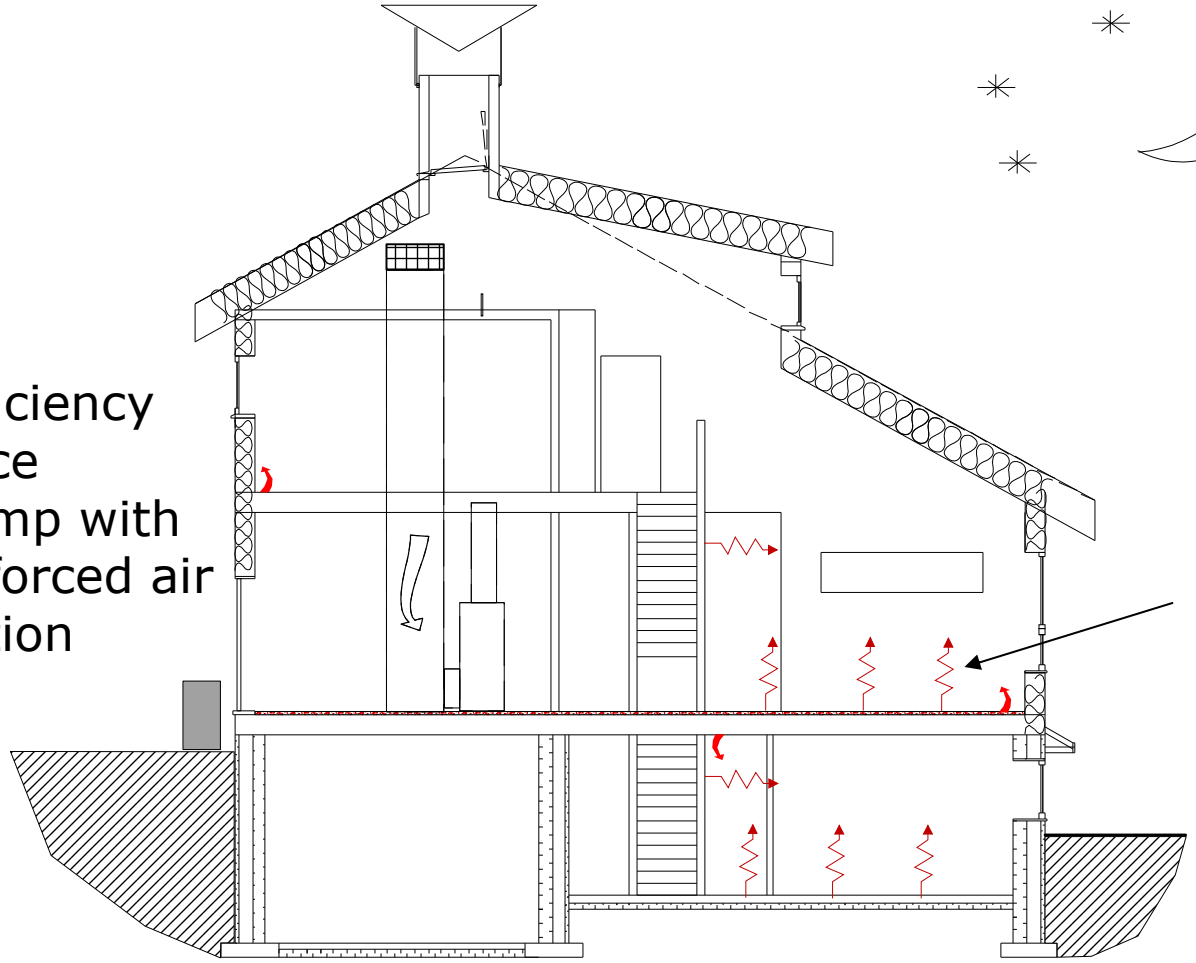
- South windows distributed across south façade
- Use inherent mass of building
- Additional mass could take the form or 1” thick elevator shaft liner drywall or double layer 5/8 type X
- 1 ½” concrete top coat over wood subfloor
- Currently 3.7% of heated floor area in south facing windows
- Forced air heating system for redistribution of solar gains

Winter Day
PV Powered High Efficiency Air Source Heat Pump



Winter Night
PV Powered High Efficiency Air Source Heat Pump

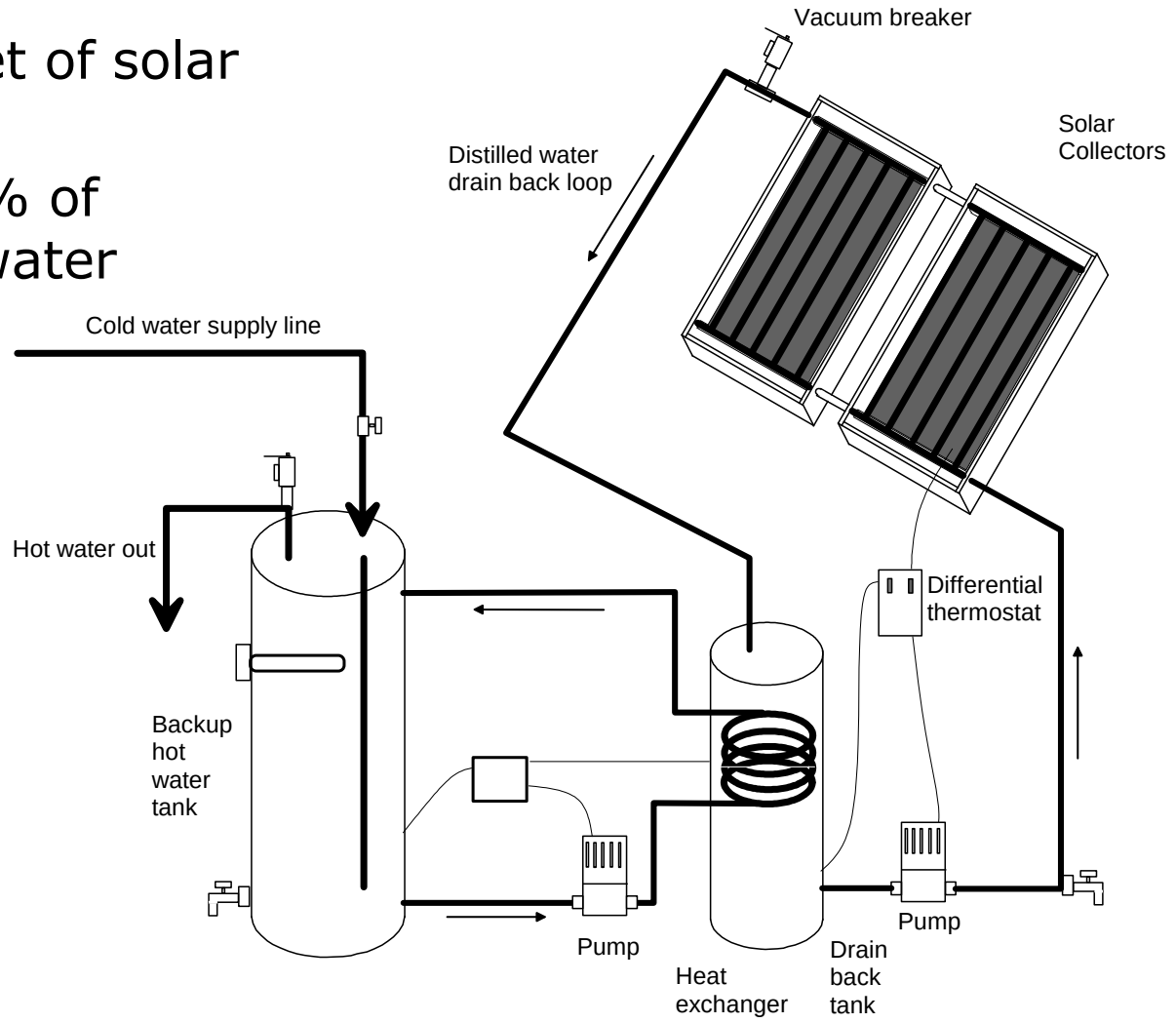
High efficiency air source heat pump with central forced air distribution



Heat radiated from thermal mass

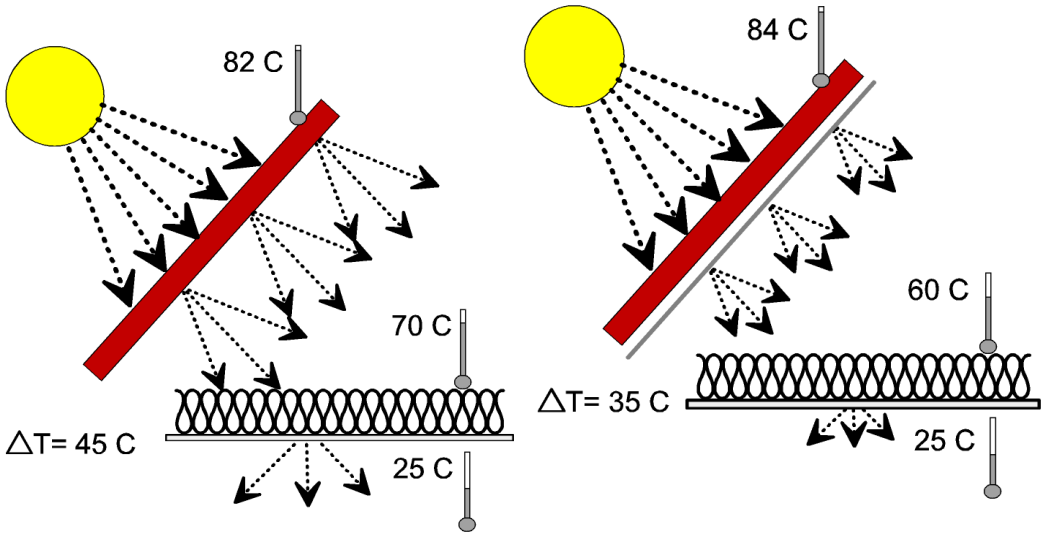
Solar Domestic Water Heating System

- 150 square feet of solar collector
- To provide 70% of domestic hot water requirements



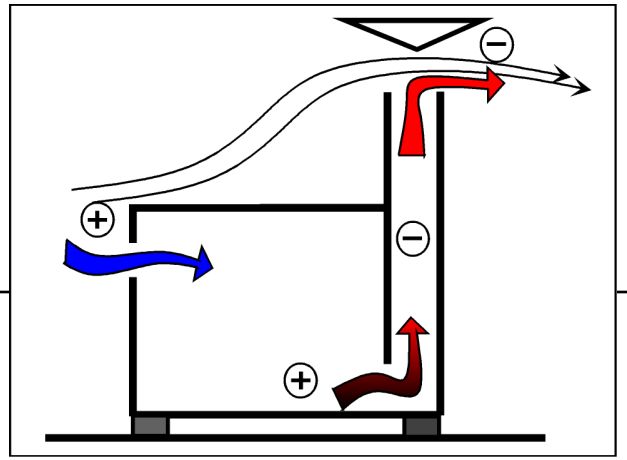
Reducing Cooling Loads

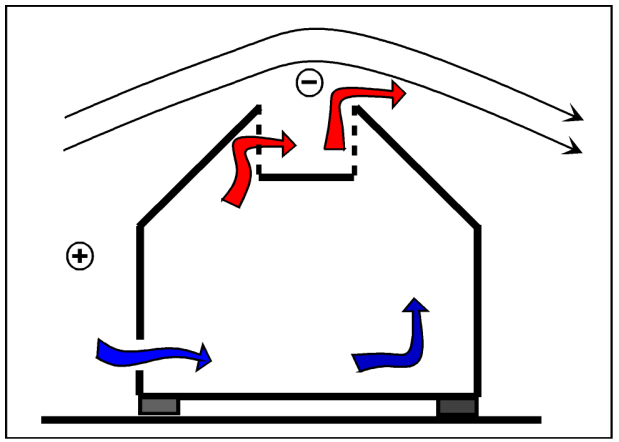
- Correctly sized horizontal shading provided for all south facing windows
- Minimize east and west winds and / or provide shading
- Attic insulation
- Radiant barrier beneath roof sheathing
- Vegetation for seasonal shading

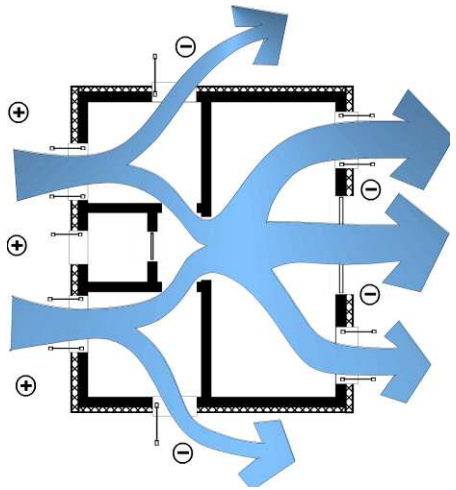


Natural Cooling

- Stack and wind driven cooling
  - Wind tower
  - Awning windows with grilles
  - Orientate openings to cooling breezes
  - 4 to 6 % of floor area in opening windows
  - Leeward windows 50 to 100% larger than windward windows
  - Reduce barriers to air flow through building
  - High ceilings to allow for temperature stratification



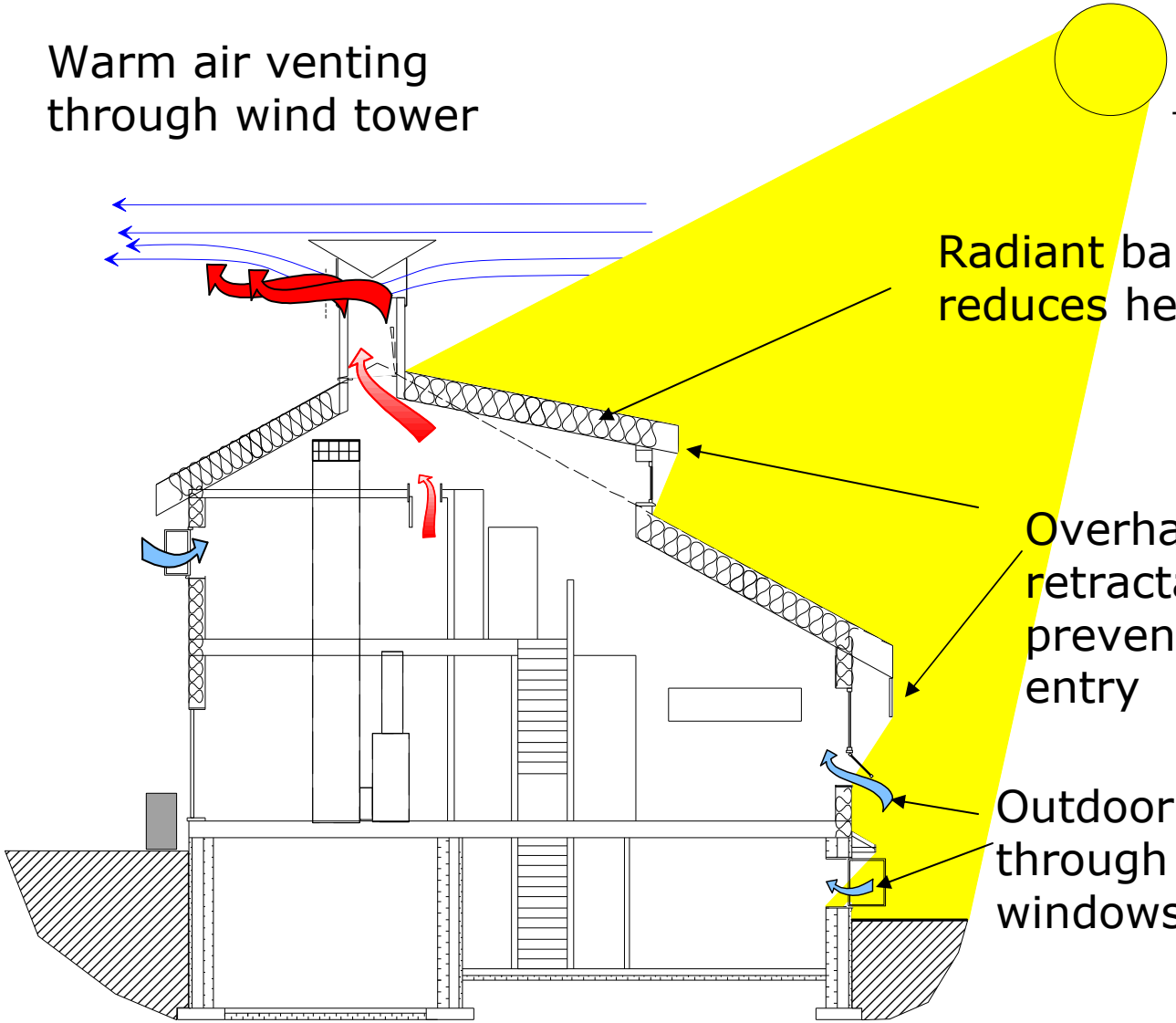




Natural Cooling

Summer Day

Warm air venting
through wind tower



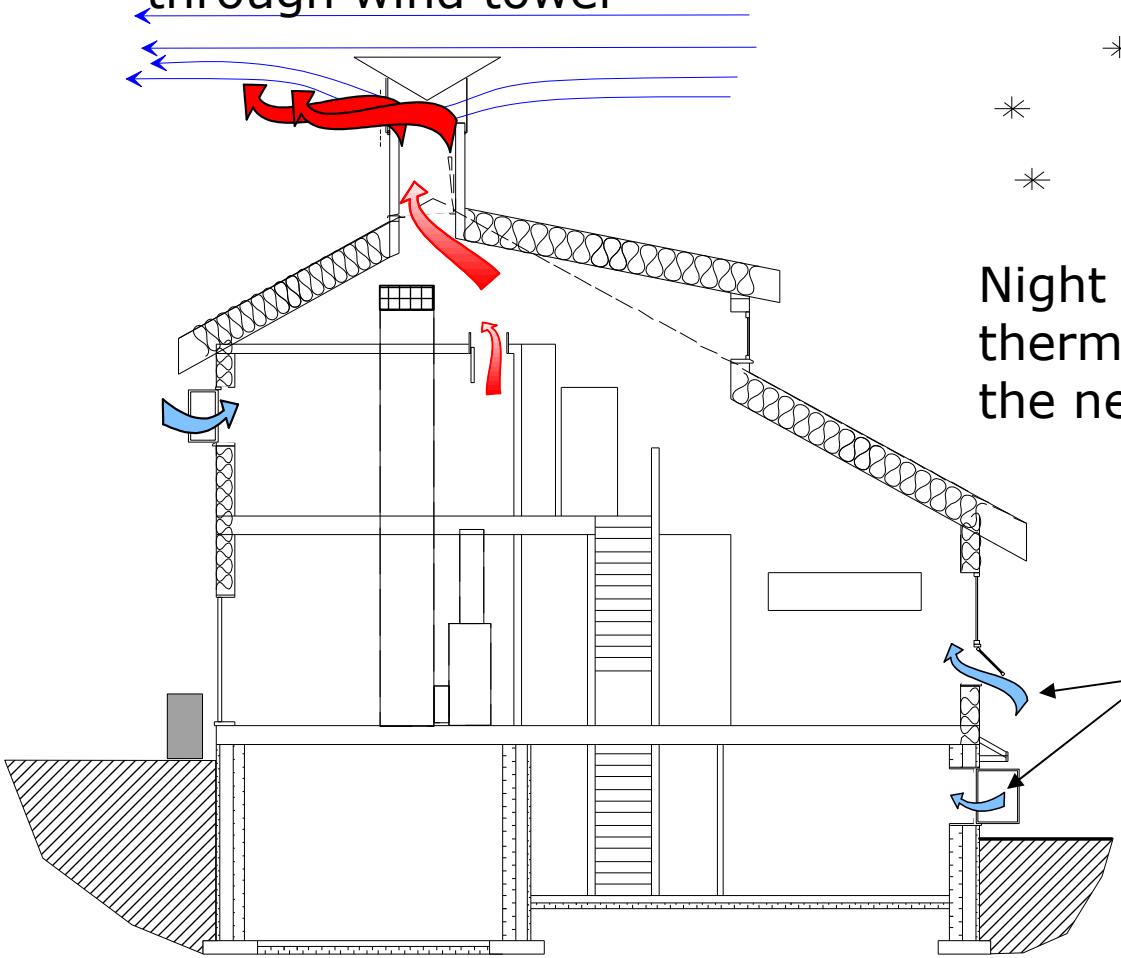
Radiant barrier in ceiling reduces heat transfer

Overhangs and retractable shades prevent sunlight entry

Outdoor air enters through opening windows

Summer Night

Warm air venting through wind tower



Night flushing cools down thermal mass for cooling the next day

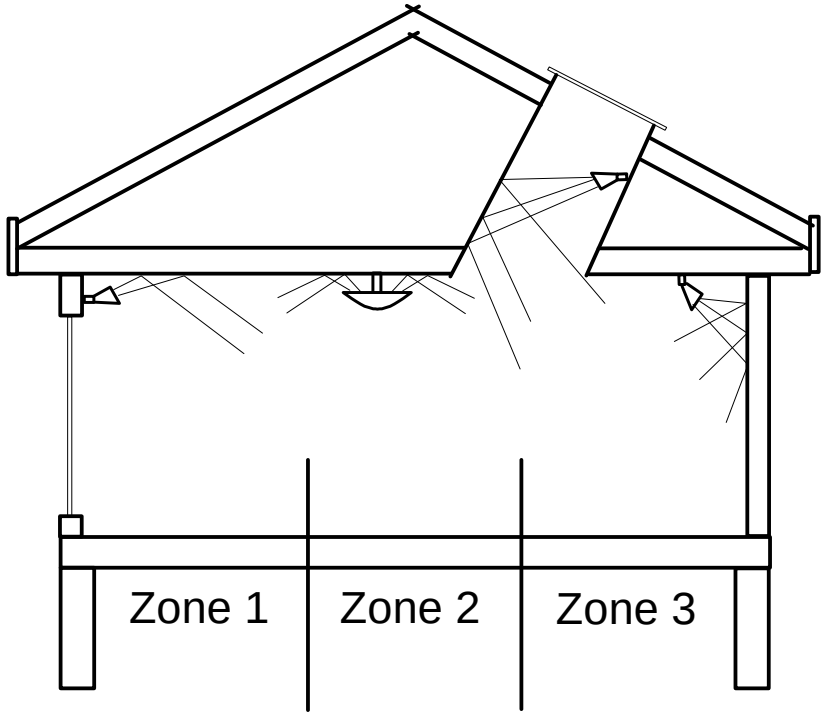
Outdoor air enters through opening windows

Lighting

- Exploit daylighting as much as possible
  - Tall windows
  - Clerestories
  - Light from two directions
  - Light coloured upper walls and ceilings
  - Light coloured exterior surfaces
- Health benefits
  - Glazings to admit UV in solarium
- Controls for electric lighting to allow daylight harvesting

Integration of Electric Lighting with Daylighting

- Zoning lighting fixtures
  - Place fixtures in individually switched rows parallel to sources of daylight



Solar Electric System

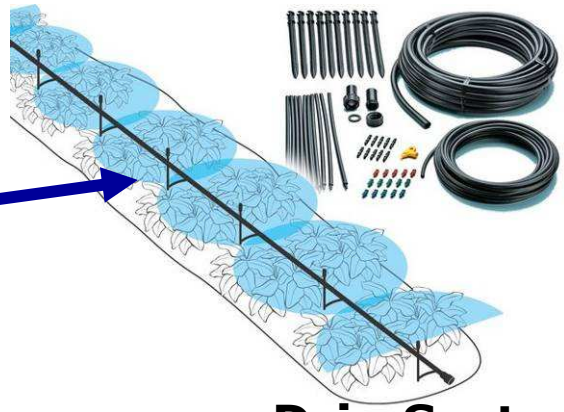
- 1200 square foot Photovoltaic (PV) array to produce enough electricity to meet the homes needs on an annual basis
- Excess power fed into the BC Hydro grid and power drawn from the grid when sunlight not available
- High efficiency lighting appliances, heating equipment and controls to minimize electrical loads

Water Conservation

- Low flow shower heads and faucets
- Low / dual flush toilets
- Water efficient clothes washer
- Rainwater harvesting
- Grey water collection treatment and reuse

Rainwater Harvesting

Timer or irrigation controller



Drip System

Resource Efficient Building Materials

- Renewables (fast growing wood, grasses etc.)
- Low pollution process (closed system, minimally processed, e.g. ISO 14000)
- Very long life
- Engineered to minimize material use
- Designed for recycling
- Uses post consumer waste
- Uses industrial waste
- Uses agricultural waste
- Produced by a process of Industrial Ecology
- Minimize transportation

Resource Efficient Building Materials

- Options- Structure
  - Engineered products
  - Low toxicity treated wood
- Options- Roofing
  - Composite shingles
  - Green roof
  - Metal roof
- Options- cladding
  - Fibre cement

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Resource Efficient Building Materials

- Options- Finishing
  - Mountain beetle wood
  - Bamboo plywood and flooring
  - Coastal species
    - Alder
    - Pacific Maple

Resource Efficient Building Materials

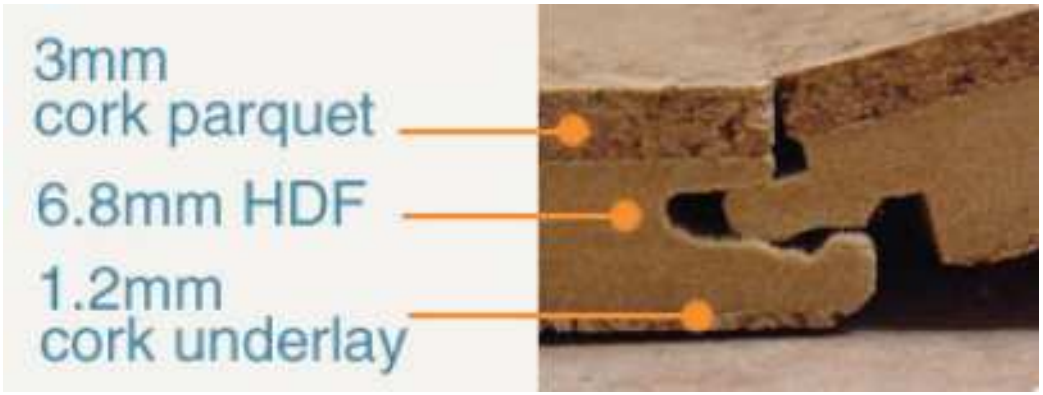
- Options- Finishing
  - Reconstituted wood
  - Recycled mineral composite tops (glass, metal, aggregates etc.)
  - Glass tile

Healthy Materials

- Minimize chemical off gassing
- Minimize particulate shedding
- Minimize growth of
  - Bacteria
  - Fungi
  - Dust Mites
  - Viruses
- Keep interior clean and dry

Healthy Materials

- Options- floor coverings
  - Linoleum sheet and tile
  - Cork tile and laminate-
    - The no vinyl house?
  - Low emission carpet
  - Wood flooring w/ low VOC finish



Healthy Materials

- Options- wall & ceiling finishes
  - Plant fibre textiles
  - Low VOC paints

Bamboo

- Bamboo
- Arrowroot
- Jute

Wood Veneer

- Domestic species
- Man-made
- Exotic species

Non-PVC

- Paper
- Cork
- Sand
- Textile
- Polyolefin
- Fiberglass
- Rice paper
- Grasscloths

Textile

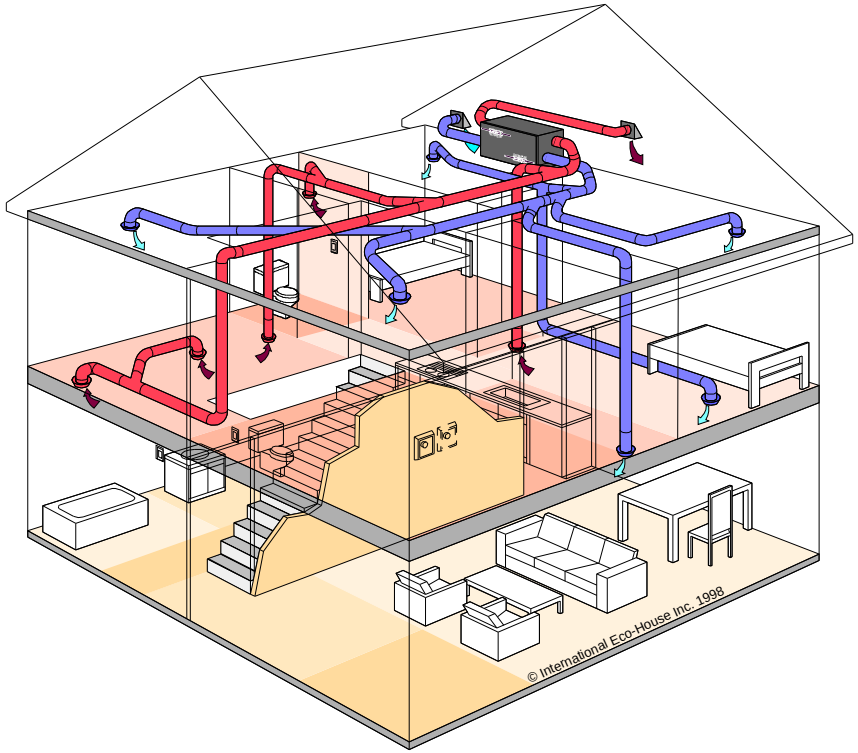
- Acrylic
- Viscose
- Polyester
- Linen
- Cotton
- Rayon

Healthy Materials

- Options- cabinet and panel materials
  - Formaldehyde free MDF
  - Exterior grade plywood
  - Solid woods
  - Low VOC adhesives
  - Low VOC finishes
  - (Kitchen Mfgrs. “green line”)

Indoor Air Quality

- Central independently ducted high efficiency heat recovery ventilation system.
- In coming outdoor air filtered for pollens, smoke and other outdoor air pollutants
- Zoned ventilation
- Low chemical emission interior finishes
- Eliminate moisture entry through the foundation



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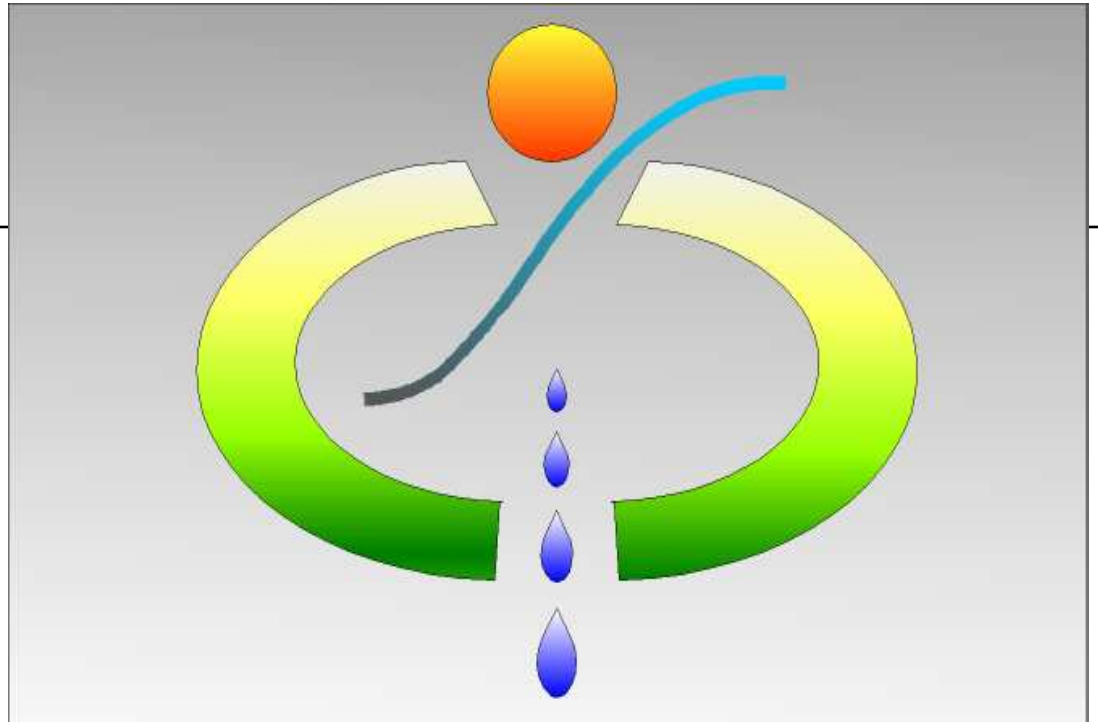

Thanks and
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