Experiences from Low Energy Houses in Canada

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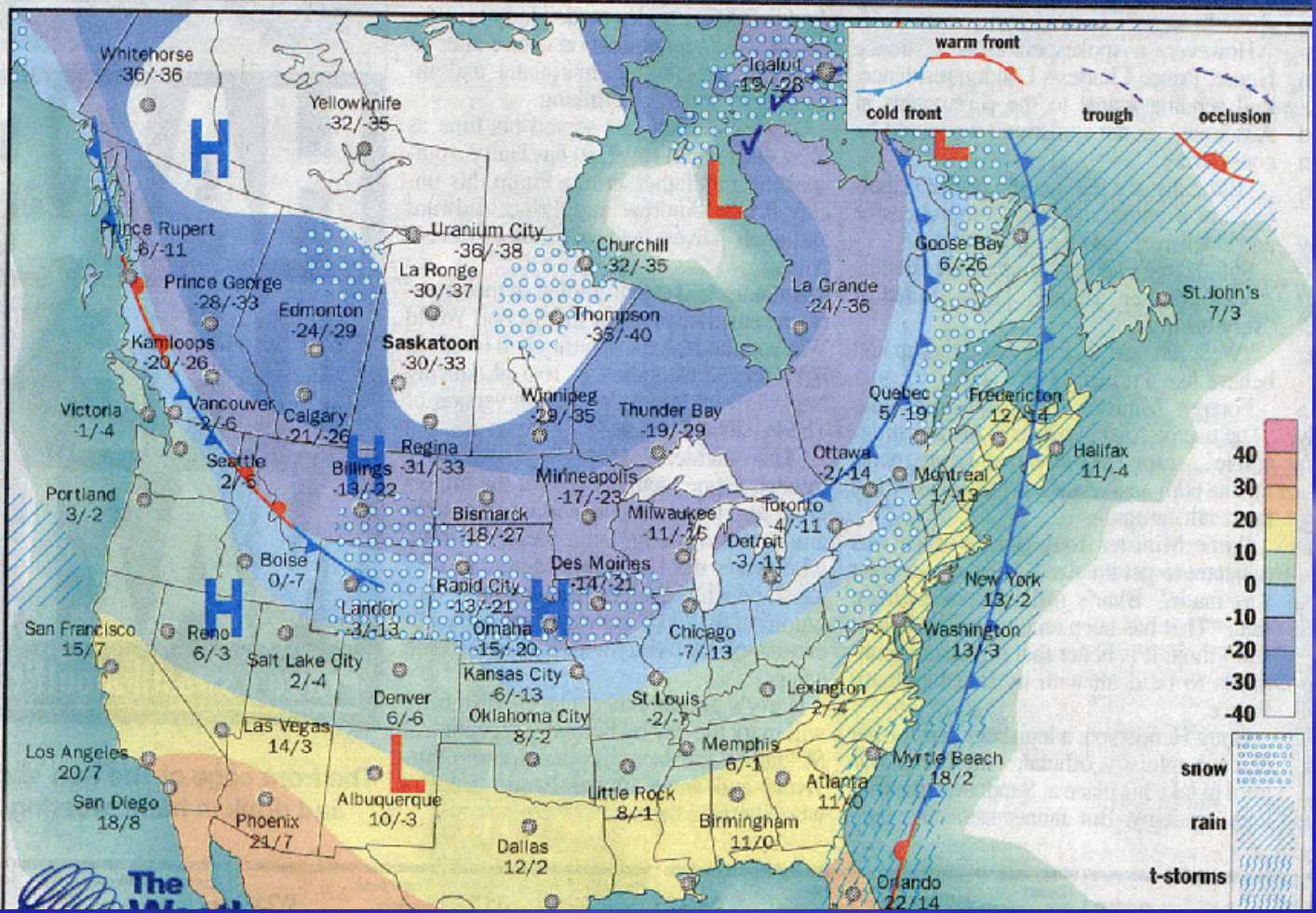
Symposium: Advanced and Low Energy Buildings in Arctic Regions, Sisimiut, Greenland, April 2005

The StarPhoenix

Weather

NORTH AMERICA TODAY



February 2005, Saskatoon

More than the sidewalks had to be shovelled that day. (Normally the snow will blow off these solar panels.)

Comparison of Saskatoon and Iqaluit, Canada Climates

(Iqaluit is about 500 km west of Sisimiut at the same latitude)

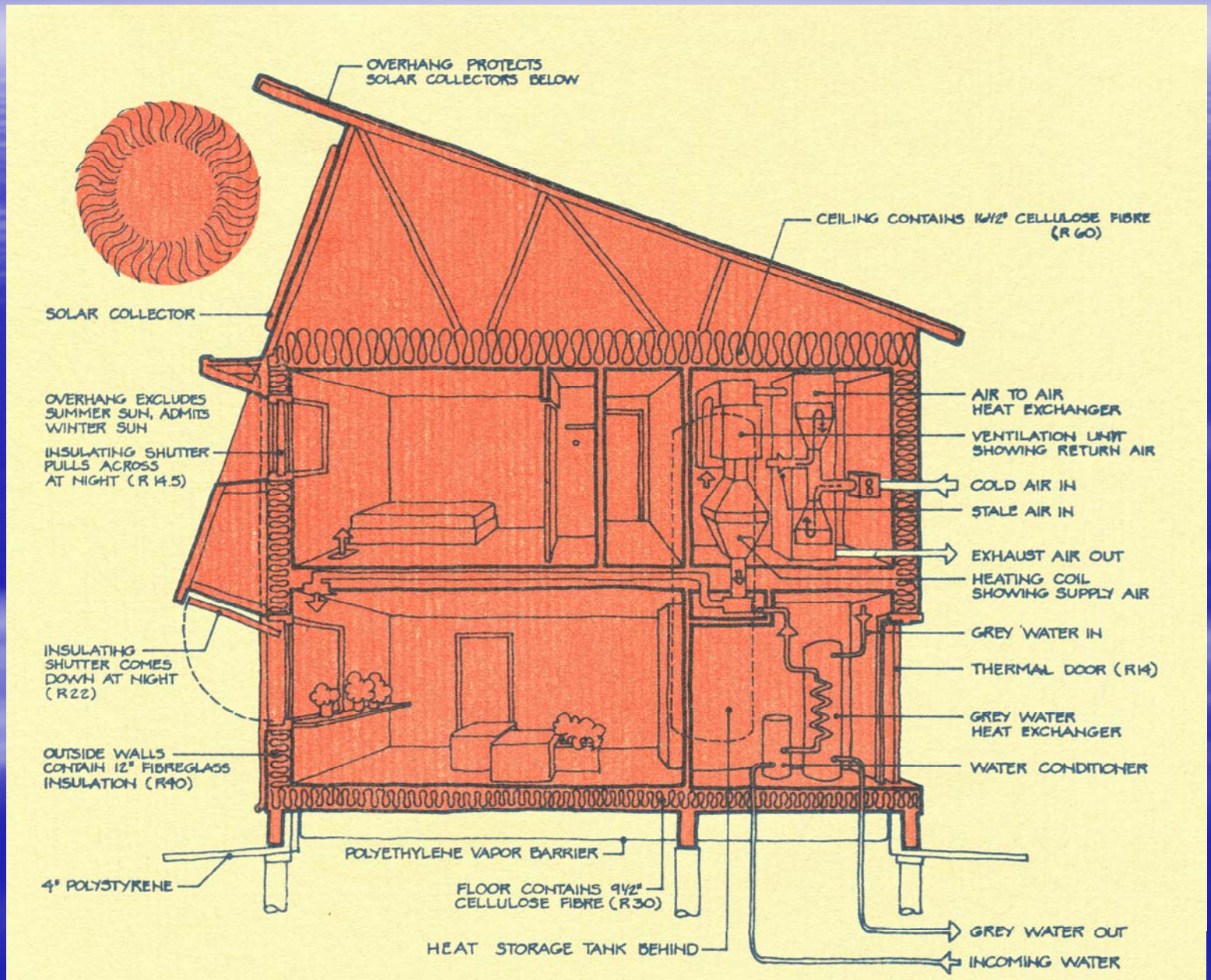
	Outdoor design Temperature (°C)	Annual Heating Degree Days (base 18 °C)
Saskatoon	-35	5950
Iqaluit	-42	10050

Some examples of cold-climate low energy houses

- 1977 Saskatchewan Conservation House
  - Regina, Saskatchewan

Note: Active Solar System Vacuum Tube Collector on South Side, and insulating shutters on south windows

Saskatchewan Conservation House



Innovative Features of the Saskatchewan Conservation House

- 1. First plastic surface air to air heat exchanger in Canada
- 2. Grey water heat exchanger
- 3. Very well sealed roof, walls and floor
- (0.8 air changes per hour at 50 pascals)
- 4. Vacuum tube solar collectors with an 11,000 litre water storage tank for heat
- 5. Insulating shutters on most of the windows
- 6. High Insulation levels: Attic RSI 10.6 (450 mm of cellulose insulation; Walls RSI 7.0 (320 mm of glass fibre batt insulation; Floor RSI 5.3 (Joist cavity with cellulose insulation)

Lessons Learned

- 1. Passive features worked very well.
- On sunny days the space heating was mostly covered by passive solar gain from the modest south windows, which were double glazed with exterior insulating shutters.

Saskatchewan Conservation House –Measured Temperatures, February 1978

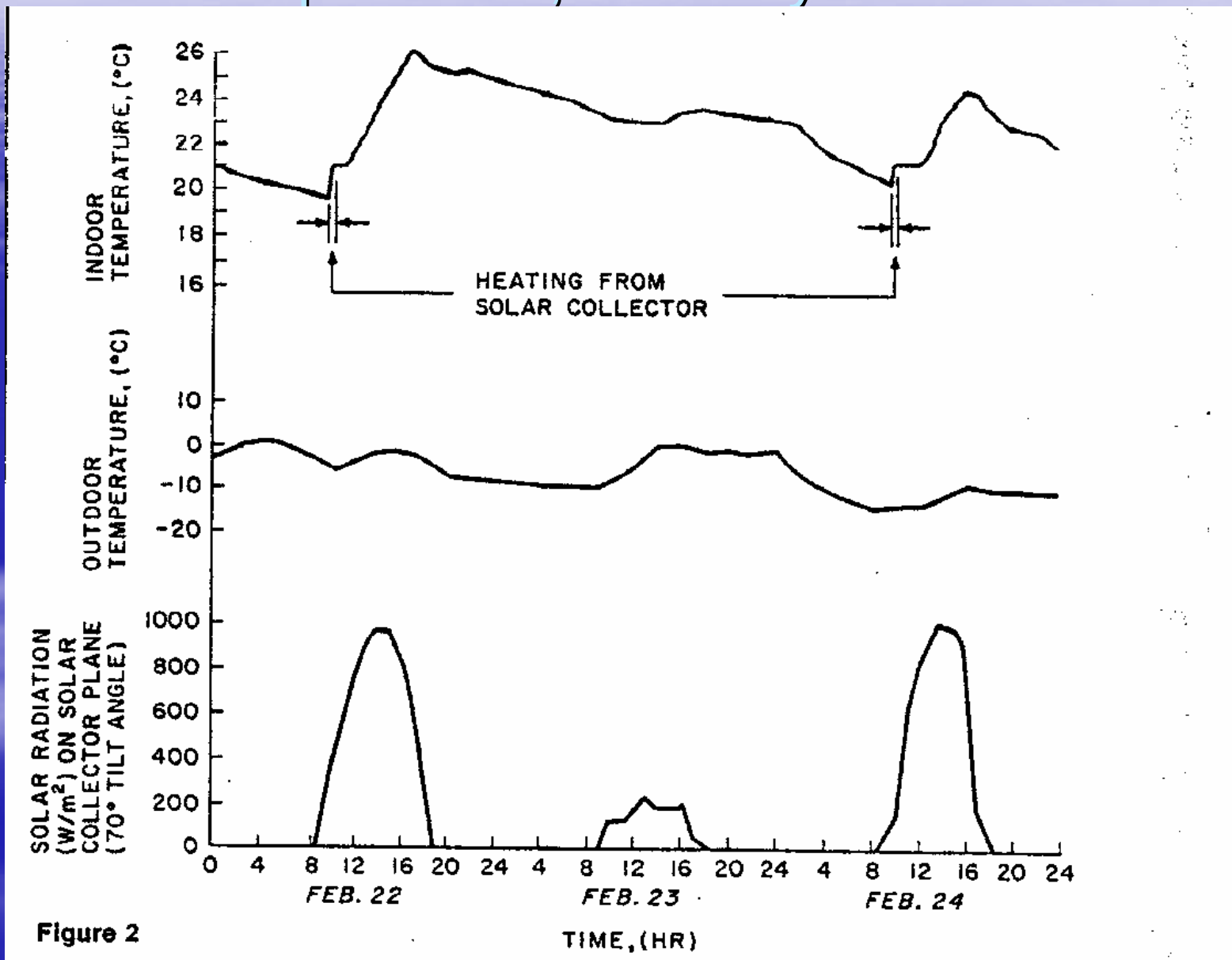


Figure 2

Lessons Learned

- 2. Features such as high insulation levels, good air tightness, and passive solar design all worked very well (and are inherently low maintenance.)

- 3. Ventilation is important.
- Most houses need about 30 L/s of outdoor air to control moisture, control carbon dioxide and body odour, and control volatile organic compound emissions.

Lessons Learned

- 4. Heat recovery on the ventilation air is very important in a low energy house. (Maintenance on air to air heat exchangers must be done, however.)
- Providing 30 L/s of ventilation air when the outdoor air temperature is -35 C requires about 2 kilowatts of heat if no heat recovery is incorporated.

- 5. In a low energy house, the internal heat gains from lights, appliances, pumps, etc. can supply a good fraction of the annual space heating requirement.
- However, it is important to use low energy lights and appliances, as the electricity used for these devices is usually much more expensive than energy for space heating.

- 6. Insulate, then insolate
- (Apply conservation measures first, and then apply the passive and active solar features.)

- 7. The vacuum tube solar panels used had a number of serious problems:
  - A. Snow would collect on the outside of the individual vacuum tubes and not melt or slide off
  - B. In a power outage on a sunny day, the glycol mix would boil and cause a vapour lock, effectively shutting down the collectors
  - C. The pressure drop through the collectors was high, requiring a high wattage pump to circulate the anti-freeze solution
  - D. The manufacturer stopped supporting the collectors, and then stopped making them.

- 8. The exterior movable insulating shutters had problems. In a high wind the shutters would rattle and shake the house. Because of this problem, the homeowner removed the shutters.
- A wise engineer once wrote: “Anything that has moving parts will fail; in fact, it must fail, because there is no such thing as a perfect bearing.”

Overall Lesson from the Saskatchewan Conservation House

- Simple is better than complicated.
- Passive is better than active
- Moving parts fail
- Keep it simple

Dumont Residence, Saskatoon, 1992

Features

- 1. “The best insulated house in the world”
- Attic insulation (600 mm of cellulose fibre)
- Wall insulation (400 mm of blown cellulose)
- Basement wall insulation (400 mm cellulose)
- Basement floor insulation (235 mm cellulose)
- Approximately 8 tonnes of cellulose insulation used in the house

- 2. High performance windows & passive gain
- Triple glazed with two low e coatings, two argon gas fills, non-metallic spacer bars, wood frames and casement design. Passive direct gain solar system (11.6 square metres of south window)
- 3. Well-sealed building envelope (0.47 air changes per hour at 50 pascals)
- 4. 15.6 square meters of active solar glycol based solar collectors with a 3000 litre water based heat storage tank.

- 5. High effectiveness (85%) air to air heat exchanger with low energy use brushless direct current motors.
- 6. Relatively energy efficient appliances
- 7. Compact fluorescent lighting
- 8. Relatively low water use appliances and exterior landscaping
- 9. Detached garage with roof sloped to accept photovoltaic panels at a later date

Lessons Learned

- 1. Insulation and passive features worked well.
- 2. A greater passive solar contribution could be achieved with somewhat larger south facing windows and newer windows with better low e coatings and gas fills.
- 3. More energy efficient appliances would be helpful.

Footnote on the Dumont Residence

- A feasibility study is underway to look at making the house net-zero in its energy supply on an annual basis. This would be done by reducing its total energy consumption from the current level of 13,500 kWh/year to 5,000 kWh/year and then using a 5 kilowatt peak photovoltaic system to supply 5,000 kWh/year.

Measured Energy Performance of Three Demonstration Houses in Saskatchewan

	Purchased Annual Energy (kWh/m^2)
Saskatchewan Conservation House	76
Saskatchewan Advanced House	92
Dumont Residence	47
Conventional Residences	**300**

Overall Lessons Learned

- 1. It is very important to develop an integrated design—one in which the entire building is designed as a system and not as a group of unrelated components.

Integrated Design

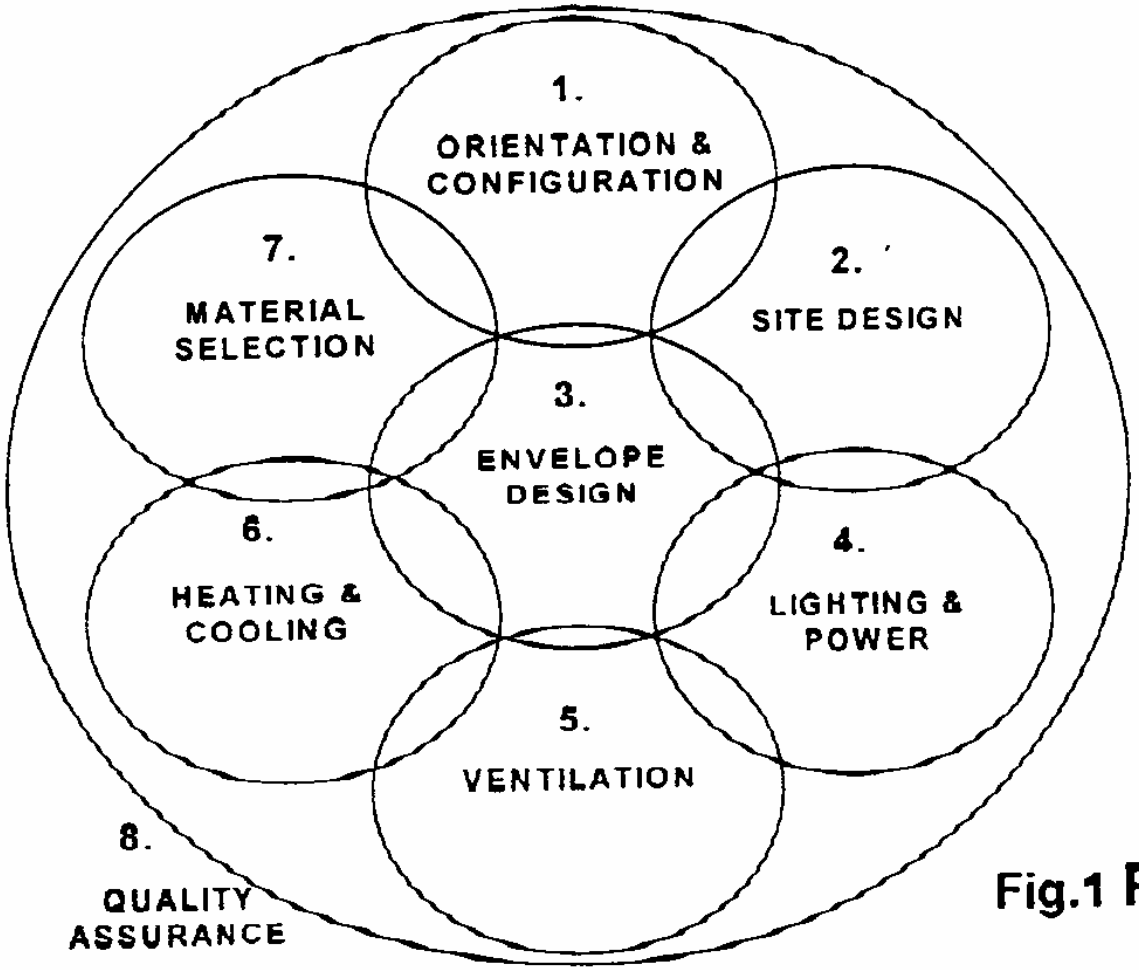


Fig.1 Pro

- 2. Energy conservation measures in the building envelope, in addition to lowering fuel and energy bills, can also reduce the capital cost of a heating system by reducing the size and possibly the complexity.
- 3. Heat recovery on the ventilation air is very important, but more work needs to be done on improving cold weather defrosting, reducing electricity use for the motors, and reducing maintenance.

- 4. In Arctic conditions, maintenance is a crucial consideration in design. Ideally systems should require zero maintenance.
- 5. Keep it simple
- 6. Keep it simple

Technologies to reduce maintenance and eliminate moving parts

- 1. High levels of thermal insulation
- 2. Excellent windows (triple, quadruple, low e coatings, argon, krypton)
- 3. Passive solar space and water heating
- 4. Thermal mass
- 5. Heat distribution using natural convection
- (thermosyphon)
- 6. Solar heating panels with thermosyphons
- 7. Naturally driven air exchange with heat recovery--unfortunately such a product is not yet available.

Acknowledgement of Sponsors

- Office of Energy Conservation, Government of Saskatchewan
- Saskatchewan Research Council
- Natural Resources Canada

- *Their participation is gratefully acknowledged, along with the Nukissamik atuiffiulluartumik sanaartorneq organization*