

December 1, 2003

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Meeting Notice

Tuesday  
December 9, 2003  
@ Ramada Hotel & Golf Dome  
Manitoba Room

*Bring  
your  
Clubs to  
hit a few  
at the  
Golf  
Dome*

***Past President's Night***

5:30 - 6:00	Cash Bar
6:00 - 6:45	Supper
7:00 - 7:30	Chapter Meeting
7:30	Golf Dome for Drinks

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AMERICAN SOCIETY OF HEATING, REFRIGERATING, AND AIR-CONDITIONING ENGINEERS

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ASHRAE  
SASKATOON

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**Newsletter**  
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# Funspiel

The local chapter "funspiel" will be held Saturday, February 28, 2004 at the Granite Curling Club, starting at 3:00 P.M. Followed by dinner. Family, Partners and friends welcome. Jack will have a sign up sheet at the next meeting.



## Message from the Treasurer



If you have not already done so please pay for your meal plan. Thank you.



## Energy Answers

Rob Dumont

### *What are the Seven Sisters of a good indoor environment?*

I once heard a talk by a Norwegian heating and ventilating engineer who spoke very eloquently of the Seven Sisters.

Here are his Seven Sisters in no particular order.

1. Temperature
2. Light Levels
3. Sound and Vibration
4. Flora and Fauna
5. Electromagnetic Fields
6. Indoor Air Quality
7. Psychological and Social Environment

People who design buildings should be aware of each of the Seven Sisters, and try to design to get each of the Sisters right. Take heating systems, for example. A bad heating system will obviously affect temperature, but can also affect sound and vibration (noisy duct systems, motor vibrations) and indoor air quality (chimney backdrafting, cracked heat exchangers, carbon monoxide producing burners). Moisture from air-conditioning coils can cause bacteria and mould to grow, affecting the Flora and Fauna.

As I mulled the Seven Sisters list, I recalled various incidents in my life where one of the Seven Sisters was acting up or otherwise not right.

## 1. Temperature

On the hot side, I once worked at Kitimat (as did our esteemed Solplan Review Editor) where aluminum oxide powder is converted to aluminum metal using an electrolytic refining process. This is a hot process, both in terms of temperature (the melting point of aluminum is about 550 °C) and electromagnetic fields (electric currents of 100,000 amperes are typically used in the cells.) Because of the risk of scalds from hot metal, we wore wool sweaters and wool pants and leather gloves, none of which are great for hot environments. One of my co-workers there walked with a pronounced limp. At one time he had stepped through the crust of an electrolytic cell and his leather boot touched the molten aluminum.

On the cold side, there is little to compare with walking across a Saskatoon bridge when the air temperature is about -30°C and the wind is howling. It's enough to make you forget Kitimat.

The ASHRAE people suggest that the comfort zone indoors for temperature in summer is between about 23°C and 27°C for typical summer clothing and primarily sedentary activity. In the winter, the comfort zone is between about 20°C and 24°C for typical winter clothing and primarily sedentary activity. In general, the lower the relative humidity, the higher the allowable temperature. Some studies have been done to show that if people have some control over their environment such as an openable window, they will accept a broader temperature range.

## 2. Light levels

Once while working in Nairobi, Kenya, which is located at about a mile above sea level, I was coaching a team in a multi-game outdoor basketball tournament held during the day. Being brought up in Vancouver's lower rainland, I was not accustomed to such bright clear days! I got a dose of sun-stroke, both from the high outdoor light levels and the temperature at the equator (the atmosphere is thinner at high altitudes, and Nairobi is at a 1700 metre elevation. Thus the light levels and solar radiation levels are also higher). Only mad dogs and Canadians go out in the midday sun. Outdoor light levels on a bright sunny day are approximately 100,000 lux (lumens/square meter) [9300 foot-candles].

For office work these days in Canada, light levels in the range of about 300 to 700 lux are typically seen. As more people are using computers these days, acceptable light levels are falling.

In Sri Lanka, where electricity is very expensive relative to incomes, a level of 150 lux is the current standard for offices. On my desk the Lutron light meter reads about 250 lux.

## 3. Sound and Vibration

I once attended the rock movie Tommy that was likely run by what must have been a deaf projectionist. I spent the better part of the show with my fingers covering my ears.

The human ear, like the human eye, is not a linear receptor. We can hear sounds as low as a very faint 10 decibels to levels higher than 120 decibels. Apparently at some higher sound level your eardrums will burst and you will likely bleed through your ears. In the sound frequency range from 500 hz to 5,000 hz, the tolerable sound pressure variation is about 1,000,000,000,000 to 1.

## 4. Flora and Fauna

Plants and Animals. The Winnipeg Zoo has, or had, an indoor planetarium with lots of flora and fauna in it. In the wild, the faeces from the bird life can be dissipated back to nature without too much problem. In an enclosed environment the faeces smell can be overwhelming. Sorry, Winnipeg. Most animal enclosures suffer the same fate.

It is of interest that many people do like both living flora and fauna in their homes, as the proliferation of tropical plants and pets can attest. Most people, however, draw the line at ants, silverfish, cockroaches, mice, rats, etc. People with allergies generally do not do well in indoor environments with lots of flora and fauna.

Dust mites in homes are strongly associated with allergic reactions.

## 5. Electromagnetic Fields

My story goes back to Kitimat and the summer of '64, where the electrolytic cells carried direct currents of 100,000 amperes. We often worked adjacent to the aluminum bus bars that carried these currents. Because of the high electromagnetic fields, our shoes could not have any iron in them, and we were told not to wear watches.

Apparently even the small currents that exist in electric blankets can cause some damage. Newer blankets always have two wires side by side with the currents in opposite directions. The AC electric currents from the two adjacent wires cancel out the electromagnetic fields. (And yes, I did use an old electric blanket with individual wires generating electromagnetic fields for several years!)

We heard quite a bit about electromagnetic pollution lately. It is known that certain electrical workers in high voltage electricity are more prone to cancer than the average population. For office workers, the electromagnetic radiation off the computer can be a concern.

## 6. Indoor Air Quality

There are many factors that affect indoor air quality (relative humidity, volatile organic compounds (usually from emissions from building materials and furnishings), dusts, vapours, pollen, viruses, etc.

Tobacco smoke is a particularly nasty indoor air contaminant, annually killing about 40,000 Canadians and about five million people globally from the direct effects of smoking, and affecting the health of many people through second hand smoke. Over 2000 chemicals have been identified in tobacco smoke, and at least 50 of the components are known to have adverse health effects. Anyone who complains about indoor air quality and continues to smoke is a hypocrite. Here's what the Canadian Exposure Guidelines say about tobacco smoke: It is recommended that any exposure to tobacco smoke in indoor environments be avoided... Symptoms reported by non-smokers exposed to such sidestream smoke include eye, nose and throat irritation, headache, nausea, dizziness and loss of appetite. Furthermore, the lingering odour and reduced visibility from tobacco smoke are aesthetically unpleasant to many people... it is widely believed that there is no level of exposure to carcinogenic substances below which a risk does not occur. My story here is that my father, a physician no less, used to enjoy cigars. I didn't, and still don't.

For relative humidity, the Canadian guideline for summer conditions is 30% to 80%; for winter conditions the range is 30% to 55% unless constrained by condensation. A much smaller range, however, of 40% to 50% is suggested as a humidity level that reduces the incidence of upper respiratory infections and minimizes adverse effects on people suffering from asthma or allergies. Too high a humidity will often result in condensation and mould problems in a house.

The Exposure Guidelines for Residential Indoor Air Quality from Health Canada provides guidelines on many other air contaminants. For office environments, the booklet "Indoor Air Quality in Office Buildings: A Technical Guide" by Health Canada provides similar guidelines.

For volatile organic compounds, typical levels which we have measured in Canadian homes have averaged about 0.5 milligrams per cubic metre. We measured, however, one home that was being polluted by leaking gasoline from an adjacent service station. The level measured was over 100 milligrams per cubic metre. When we entered the house, the odour was so overpowering that you lost your sense of smell. A Danish Researcher suggests that when total volatile organic compound levels are above about 3 milligrams per cubic metre that discomfort will result. Above 25 milligrams per cubic metre, the level is regarded as toxic. The European Community has prepared a target guideline of 0.3 milligrams per cubic metre, where no individual volatile organic compound should exceed 10% of the total volatile organic compound concentration.

## 7. Psychological and Social Environment

This is certainly not my area of expertise, but without a decent psychological and social environment, life can rhyme with strife.

It is one of the characteristics of human beings that, generally speaking, we can tolerate only a relatively narrow band of environmental parameters. If the temperature, light levels, sound levels, flora, fauna, electromagnetic fields, indoor air quality, etc. are not just right within relatively narrow bands, we complain. Take temperature, for instance. Temperatures can vary from a low of -273°C to hotter than 5700 °C, the surface temperature of the sun. Yet we are comfortable indoors only when the temperature is between about 20°C and 27°C.

If I interpret the Seven Sisters properly, most of them are Goldilock parameters. In other words, the parameters of temperature, light, sound, vibration, and flora and fauna must neither be too strong, nor, too weak.

In times past, most people could be satisfied if the temperature and the light level in a space were controlled. Now most people will insist that the Seven Sisters are all under control.

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