INFLUENCE OF THE TYPE OF ICE RINK CEILING

BACKGROUND

Reference conditions

Infrared radiation from an ice rink ceiling represents up to 30% of the ice sheet refrigeration system load.

On sunny days, the arena roof surface can reach temperatures well above the ambient outdoor temperature. Heat is transmitted by conduction to the inside of the ice rink area ceiling. The temperature, colour and emissivity index of the inner surface of the ceiling are the main causes of the radiation thermal load to the ice rink.

Common materials used for ceilings (wood, steel, etc.), have an emissivity index (e) of between 0.85 <e< 0.95. These high emissivity indices promote radiation heat transfer from the ceiling to the ice surface; thus increasing the refrigeration load.

Proposed improvements

To reduce the cooling load due to ceiling radiation, at least four options could be considered:

- Install a suspended ceiling of low-emissivity aluminized cloth;
- Cover the ceiling directly with a aluminum-based low-emissivity (0.05) paint;
- Install a suspended ceiling made from an opaque cloth with an emissivity index of 0.85;
- Paint the ceiling with a low-emissivity (0.24) paint.

BENEFITS

Direct impacts

- Refrigeration system energy consumption is reduced by 93,000 kWh a year, or 14% of the total refrigeration system consumption and nearly a 7% saving of the total energy consumption.
- The refrigeration load due to ceiling radiation is reduced to 15% or 16% of the total refrigeration load, or a reduction of nearly 50% of the radiation load.

Indirect impact

- For same brightness, the reflectivity of low-emissivity ceilings allows for a reduction in the lighting power demand (the resulting reduction in electricity consumption is not considered in this fact sheet).
- Condensation of water vapour on the building structure above the suspended ceiling is reduced.
- Improved arena acoustics.

REFRIGERATION SPECIALIST'S REMARKS

Simply adding a canvas false ceiling between the ice rink and the arena roof will reduce electricity consumption by 77,000 kWh a year. This is more than 80% of the potential reduction in energy consumption calculated for a low-emissivity polished aluminum-foil-faced false ceiling. In addition to masking the ceiling, the canvas false ceiling creates a lower average temperature air space above the ice rink than a roof without any masking. The quantity of radiant heat exchanged between the canvas false ceiling and the ice surface is reduced considerably.

ARENA'S ANNUAL GREENHOUSE GAS (GHG) EMISSIONS

		Total emissions* Tonnes CO_2-eq./yr
Suspended Canvas False Ceiling;	$\varepsilon = 0.05$	*260 (- 6%)*
Integrated Canvas False Ceiling;	$\varepsilon = 0.05$	*263 (- 5%)*
Suspended Polished Aluminum-Foil-Faced False Ceiling;	$\varepsilon = 0.85$	*263 (- 5%)*
Aluminum-Based Painted Ceiling;	$\varepsilon = 0.24$	*266 (- 4%)*
Reference Ceiling;	$\varepsilon = 0.85$	*278 (Ref)*

* Calculations of GHG emissions include electricity, fossil-fuel energy and refrigerant leaks.

NOTE: Energy consumption and energy savings were estimated on the basis of Montréal's 1996 climatic profile. Readers may refer to the technical fact sheet "Reference Arena".

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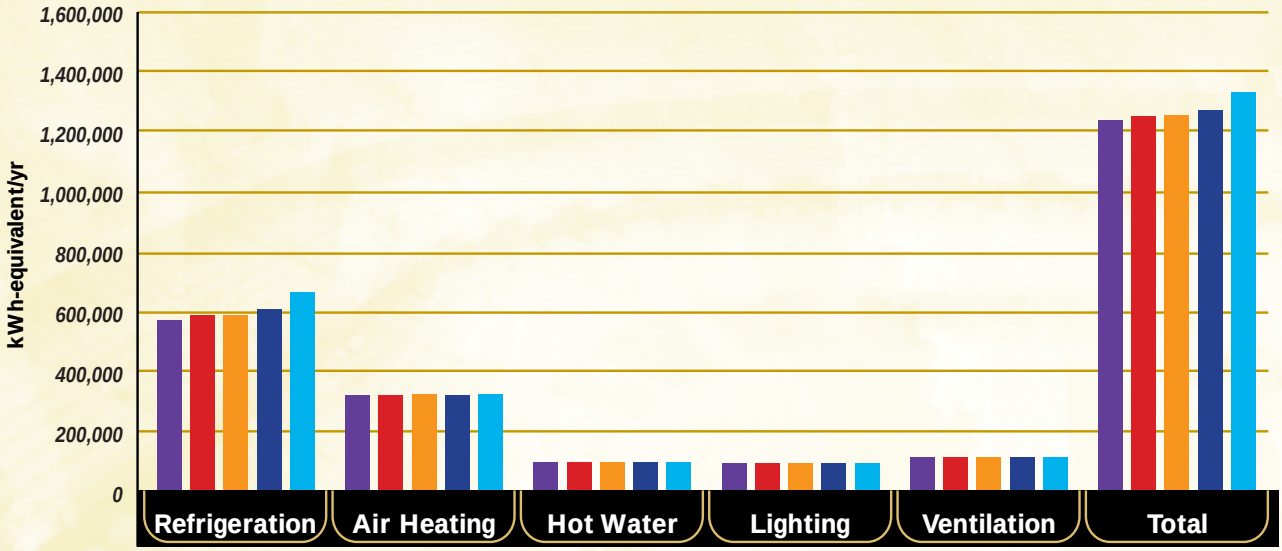
http://cetc-varennes.nrcan.gc.ca/fr/publication/2003-066-1f.html.

INFLUENCE OF THE TYPE OF ICE RINK CEILING

Arena's Energy Consumption



Ceiling	kWh-equivalent/yr					
Suspended Canvas False Ceiling; ε = 0.05	577,000 (-14,%)	329,000	105,000	102,000	124,000	1,237,000 (-7%)
Integrated Canvas False Ceiling; ε = 0.05	592,000 (-12,%)	329,000	105,000	102,000	124,000	1,252,000 (-6%)
Suspended Polished Alluminum-Foil-Faced False Ceiling; ε = 0.85	593,000 (-12,%)	329,000	105,000	102,000	124,000	1,253,000 (-6%)
Aluminum-Based Painted Ceiling; ε = 0.24	611,000 (-9,%)	329,000	105,000	102,000	124,000	1,271,000 (-5%)
Reference Ceiling; ε = 0.85	670,000 (Ref.)	330,000	105,000	102,000	124,000	1,331,000 (Ref.)

Figure 1

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