Listening Session on Indoor Air Quality with David Bearg, Building Scientist

Goal:

Delivering generous amounts of outdoor air, while minimizing cost and energy consumption.

How generous does the amount of ventilation air need to be to keep indoor levels from exceeding 800 ppm?

That depends,

On what the outdoor CO_2 level is

Relevant equation:

$$\frac{\text{CFM}}{\text{Rate}} \quad \text{Person} \quad = \quad \frac{\text{CO}_2 \text{ Generation}}{\text{CO}_2 \text{ IN} - \text{CO}_2 \text{ OUT}}$$

How generous does the amount of ventilation air need to be to keep indoor levels from exceeding 800 ppm?

If outdoors = CFM/Person	Then,
430 ppm	25.8
460 ppm	28.0
490 ppm	30.8
520 ppm	34.0
550 ppm	38.1

Pathway for achieving this goal:

Minimize resistance to air moving through the building by reducing and even eliminating ductwork.

This would be achieved by having penetrations in the interior of the building that allow this ventilation air to move through the building with a minimum of resistance.

How would this work
On the coldest day of the year:

Thermal buoyancy of the heated indoor air would provide a considerable amount of driving force to draw air through the building. This driving force for air movement might even be able to overcome the pressure drop of the filters and heating coils needed to condition the outdoor air.

How would this work
On the hottest day of the year:

Insufficient thermal buoyancy of the indoor air to drive the needed ventilation air through the building, but fan assist would kick in. Expecting strong solar isolation of this hot day, the solar PV would be available to drive the fan operation.

Other design considerations:

Thermal conditioning of the outdoor air and occupied spaces would be achieved by ground source heat pumps technology.

Position of modulating dampers for ventilation would be controlled by accurate CO_2 measurements.

Other design considerations:

Airflow geometries for both the occupied spaces and the building itself would be in low and out high.

This is displacement ventilation and it is more effective than mixed air ventilation in diluting and removing air contaminants from occupied spaces.

Another Benefit of solar PV Fan-Assisted Natural VENTILATION

RESILIENCE

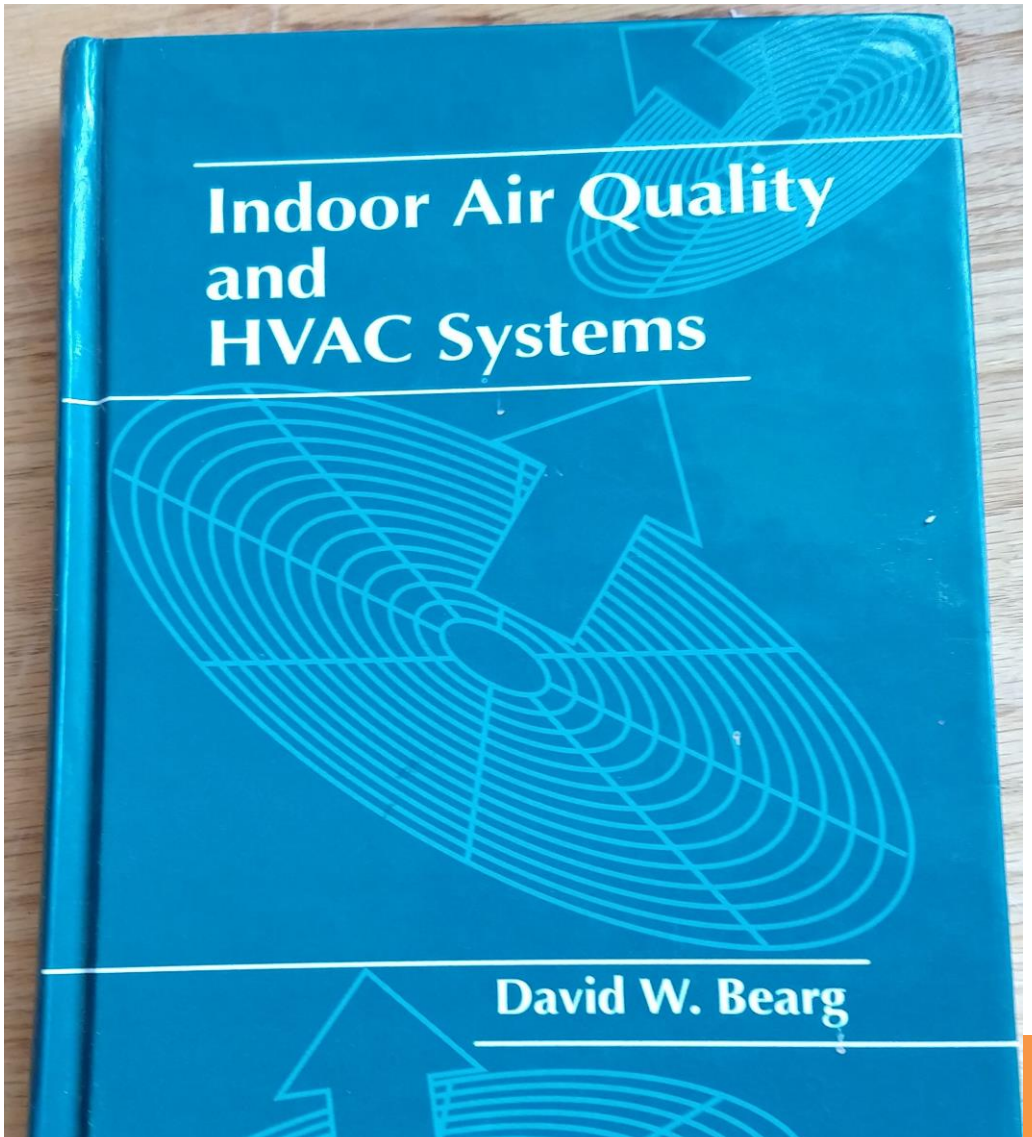
Ability of the building to function if and when the electrical grid were to go down.

Supports Community Resilience Goals

(Article 23, 2018 Town Meeting) by creating local resilience to climate change impacts in the built environment.

Let's design for the future and avoid repeating the mistakes of the past.

Problem: Hot spell in May of 2005 in the Alcott School: Classrooms Overheating



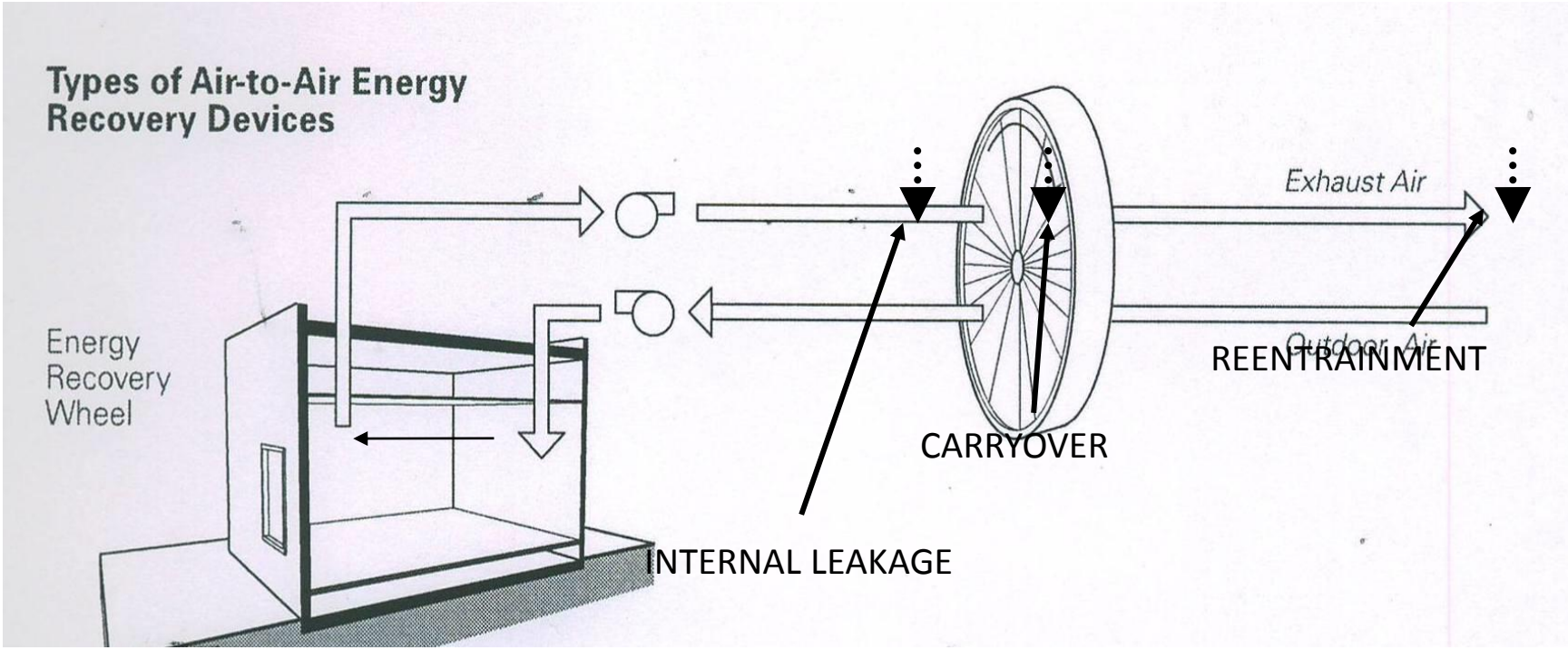
Chris Whalen, previous Town Manager asked me to determine why this overheating was occurring.

Air-to-Air Heat Exchanger at Alcott School

Energy Recovery Wheel

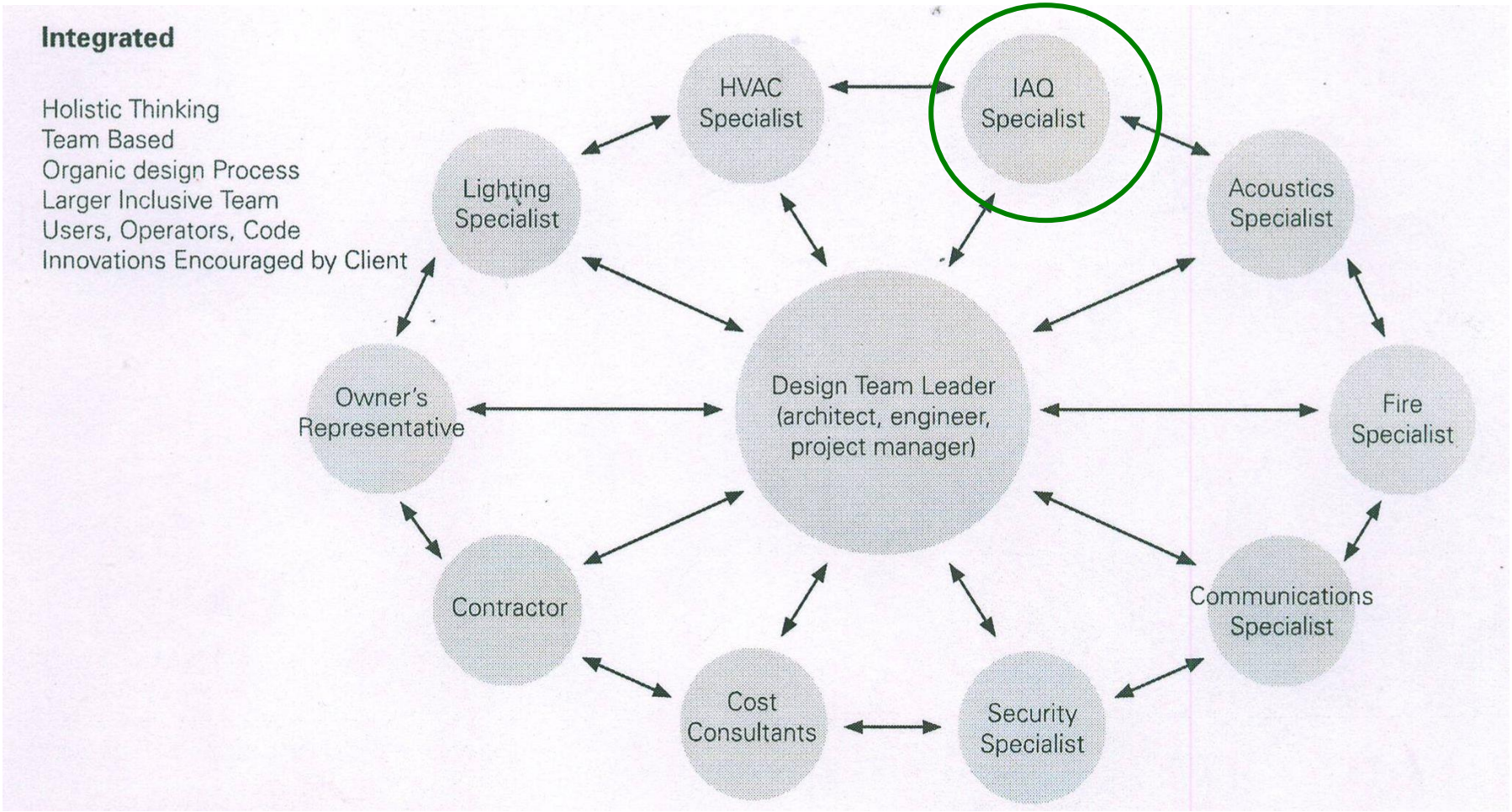
PROBLEM

LEAKAGE PATHWAYS



From: ASHRAE's IAQ Guide:

INTEGRATED DESIGN



Let's use an Integrated Design for this building and avoid repeating the mistakes of the past.

QUESTIONS?