

The Icynene Insulation System®



New Approaches to Energy Efficiency & Green Building

Control of Air Leakage and
Moisture Vapour Transmission

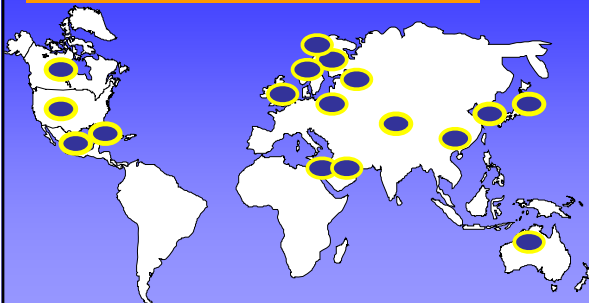
Who is Icynene Inc.?

- Founded in November, 1986 in Toronto Canada
- Product : soft low density foam insulation.
- A Green product
 - which uses water as the agent of expansion
 - contains no HCFC's, HFA's, formaldehyde
 - PBDE's or volatile organics
- An air barrier and insulation in one which is breathable

The Icynene Insulation System®

- Icynene Inc. is a member of Green Building organizations around the world
- The product has been used in "Health Houses" for asthmatics sponsored by the American Lung Association
- 21 years of experience and over 150,000 buildings of all types insulated –schools, hospitals, museums, art galleries, laboratories, churches, factories, residential

World-Wide Distribution



Buildings Contribute to Global Warming

- 40% of energy is used by residential and commercial buildings.
- 40% by transportation.
- 20% by industrial processes.

We must reduce the use of energy in modern buildings and retrofit older structures to reduce carbon dioxide emission.



Building Practices Today

- Thermal Resistance (R-Value) is still the focus of gov't and the public.
- Energy Codes are mistakenly increasing R-Value requirements.
- Increased Costs
- Condensation Problems / Mold

Types of Energy Transfer

- »Conduction
- »Convection
- »Radiation
- »Mass Transfer

Note that R-value only measures conduction

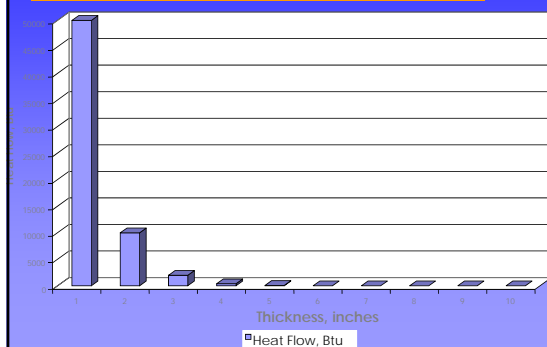
How Insulation Works

- Conduction is heat transfer through a solid material, or between two materials in direct contact.
- When a steel pot is placed on a hot stove, the handle will become hot due to Conduction.

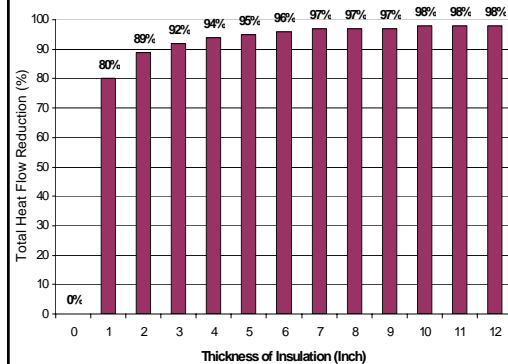


Insulation is tested for & designed for its ability to resist conduction

Diminishing Returns in R-Value

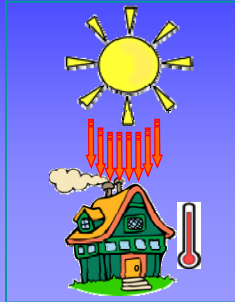


Total Heat Flow Reduction with Increasing Insulation Thickness



Radiation

- Heat from the sun reaches us by Radiation.
- Radiation is energy that moves across open spaces from warmer objects to cooler ones.
- When Radiation strikes an object, the object heats up.



Convection

- Convection is the transfer of heat by currents within a fluid.
- Hot water rises, cools, and falls.
- Heated air rises, cools, then falls. Air near a heater is replaced by cooler air, and the cycle repeats.

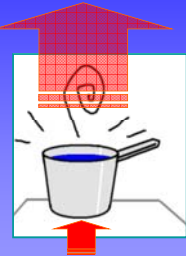


Air IS a Fluid



Mass Transfer

- As water is boiled in a stove-top pot, the water vapor carries heat with it.
- This is a form of MASS Transfer.
- Water vapor can actually store 4000 times the heat energy of dry air.
- This is the primary source of heat gain in insulated homes, due to air infiltration in warm humid climates.*



Convection? Mass Transfer?

Convection

Air movement transporting heat and moisture

Mass Transfer

Warm air can carry a great amount of water in the form of water vapor / humidity

And water vapor can store 4000 times the heat energy of dry air.

With the combination of these two, air leakage contributes up to **50%** or more of the heating & cooling loads in insulated buildings.

Air Leakage:

50 %

Air Leakage Control

- Primary Benefits
 - Helps control condensation
 - Helps control mold
 - Structural integrity / durability
 - Improves Indoor Air Quality
 - Health of building & occupant
 - Controls Drafts
 - Improves Energy Conservation

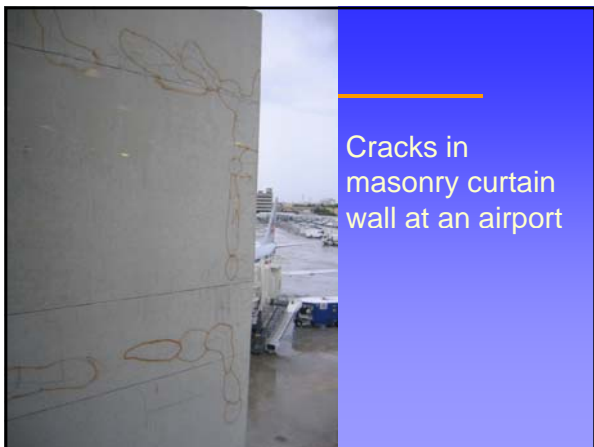




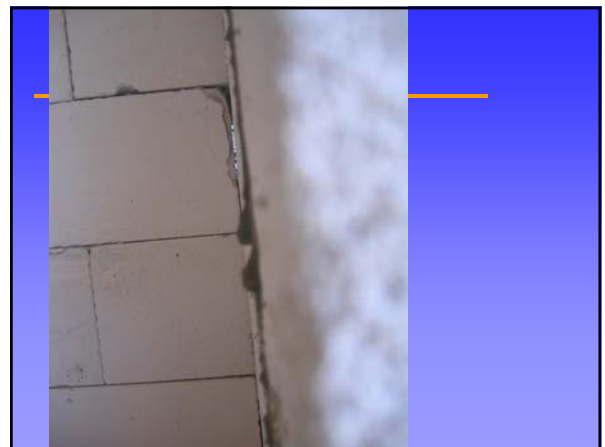


Common Air Leakage Pathways

- Cracks in masonry
- Poor or non-existent mortar joints
- Plumbing and electrical wiring penetrations to the exterior
- Improper detailing of windows



Cracks in
masonry curtain
wall at an airport



Eliminating Air Leakage: Air Barriers

An air barrier must meet the following criteria:

Low Air Permeability	→	Able to resist air flow
Continuous	→	Seal the entire building with no gaps or sagging
Durable	→	To withstand pressure changes (strong winds)
Buildable	→	Easy to install and maintain







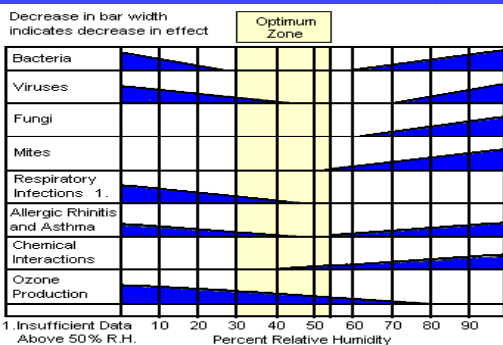
Goals

- Air Leakage Control vs. R-Value
- Strategies to improve thermal performance
- Discuss control of condensation & mold
- Introduce low-density spray-in-place foam

Status of Modern Construction

- In the last 50 years there have been significant changes in the way buildings are constructed and the materials that are used.
- People believed that doubling the thickness of insulation doubled the energy savings.

Health & Humidity



Rising Energy Costs



What is Building Science?

- The study of the response of buildings, building materials and people to:
 - »Heat
 - »Air pressure
 - »Moisture
 - »Sound



Mold

- Increased awareness of indoor air quality and mold
- Dramatic rise in asthma (American Lung Association)
 - 72% increase in children
 - 61% increase in adults



Mold

"A new study attributes nearly 100%
of all chronic sinus infections to
mold"

Mayo Clinic 1999/ USA Today



Moisture Control

How do buildings get wet?

1. Bulk Moisture / Water

- Foundation, Walls, and Roof
- Capillary Action

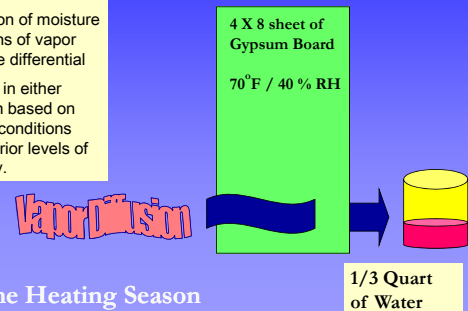
2. Water Vapor

- Air Transport
- Vapor Diffusion

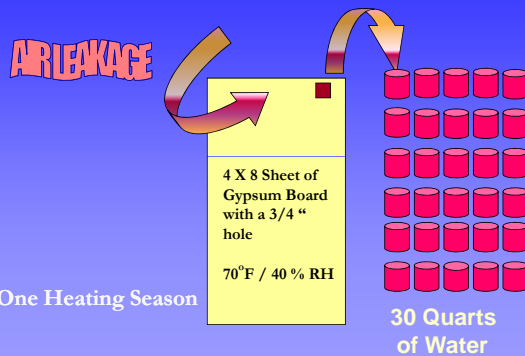
Moisture Transport via Vapor Diffusion

Diffusion

-Migration of moisture by means of vapor pressure differential
-Occurs in either direction based on climate conditions and interior levels of humidity.



Moisture Transport via Air Leakage



90% of ALL building failures in the United States are related to moisture.
ASHRAE

"Systems" Approach

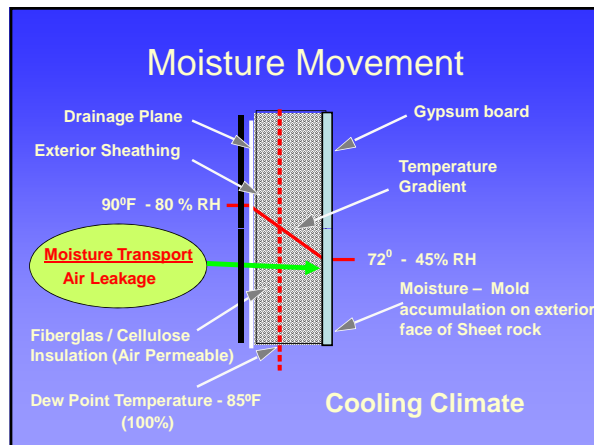
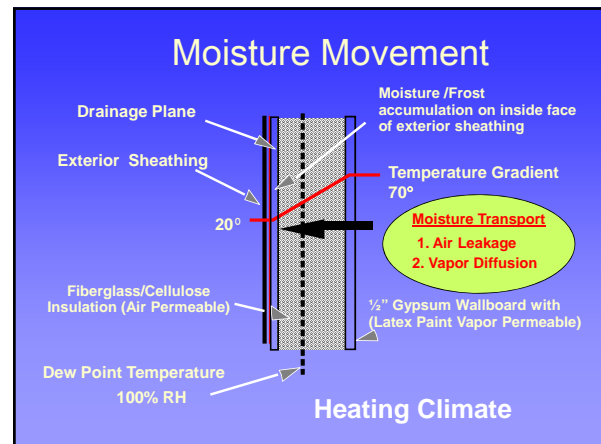
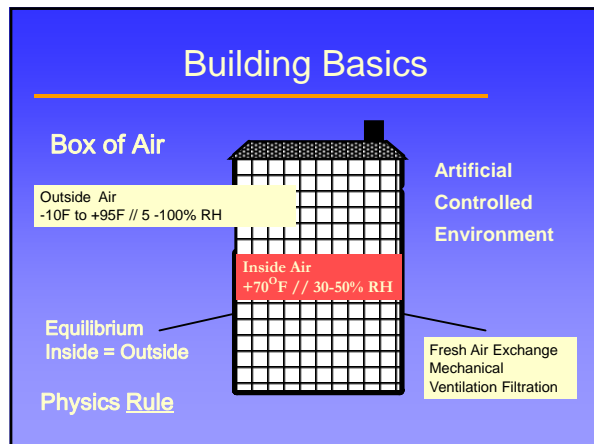
A building is not a collection of individual building materials that will perform satisfactorily as long as we toss them together.

Rather it is a sum of inter-dependent components forming a system which will perform well only if appropriate components are chosen and installed properly.

Building Basics

Box of Air





- ## What is Causing Problems?
- Deterioration of buildings due to moisture build up from air leakage and condensation.
 - Increased Air Pressures
 - Increased use of (HVAC)
 - Increased height of buildings / stack effect
 - Mechanically forced air leakage – leaky ducts

- ## Air Leakage is the Problem
- One of the causes for condensation, mould and moisture damage is air leakage through **air permeable insulation**.
 - Air Leakage brings heat and moisture from the outdoors into the building interior.
 - Cold air conditioned air will not support as much humidity in the vapor state as warm air. Condensation can occur.

- ## Common Air Leakage Pathways
- Cracks in masonry
 - Poor or non-existent mortar joints
 - Plumbing and electrical wiring penetrations to the exterior
 - Improper detailing of windows



Cracks in
masonry curtain
wall at an airport

Examples of Air Leakage Issues with New and Existing Buildings overcome with Soft Foam

- Glass Spandrel panels
- Germ and toxic chemical migration in Laboratories and Hospitals – positive pressure
- Improper detailing of windows
- Gaps where walls meet floors
- Floors projected over unconditioned space



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Buildings will get wet

- Many buildings at some time will experience water in the interior in some fashion eg. roof leaks, condensation.
- The idea that a building can be totally waterproof is virtually impossible to achieve.
- Better to design using materials which, if they do become wet, can dry and resume their function without turning into mush or distorting.

Moisture Control

How do buildings get wet?

1. Liquid Water Intrusion
 - Foundation, Walls, and Roof Leaks
 - Improper window detailing
 - Plumbing Leaks
 - Capillary Action (Rising Damp)
2. Moisture Vapour Condensation
 - Air Transport
 - Vapour Diffusion

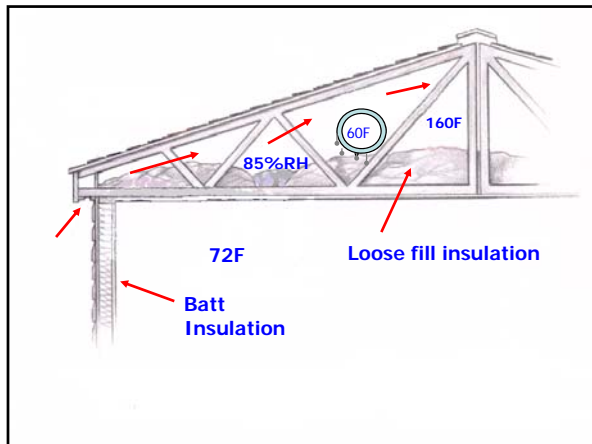


Hot Climates

- In the past, attic venting was introduced to remove heat.
- Venting was thought to prolong the life of asphalt shingles.
- Ducts installed above insulation layer in a hot/humid attic.

But.....

- Outside air is hot & humid
- Hot humid air in contact with metal ducts will condense

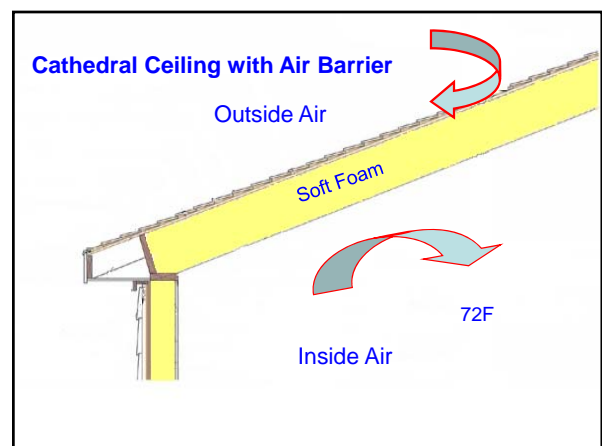
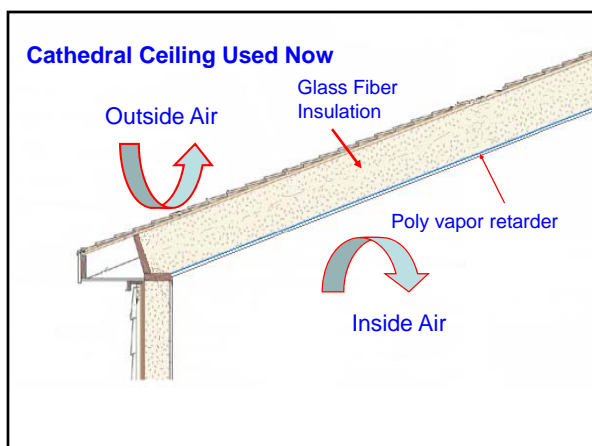


Unvented Attics resist Hurricane Force Winds better than Vented Attics

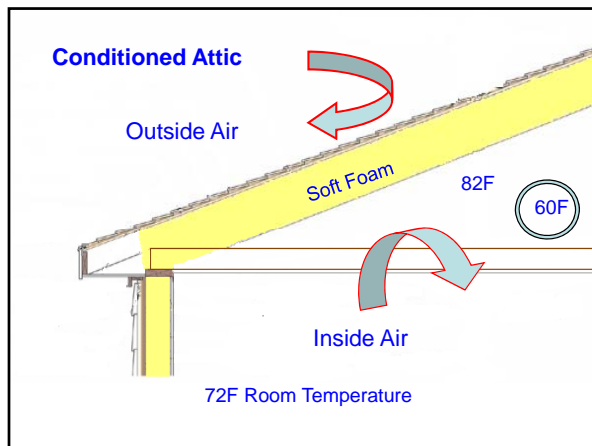


Ductwork In Attic

- Duct losses usually require an extra ton of cooling or more, and significantly increase energy consumption.



Cathedral Ceiling with Air Barrier



Recent Trends in Building Science

- Importance of Air Leakage now recognized
- R-Value not valid to predict insulation performance
- Vapor retarder / barrier losing prominence
- New Codes (IBC, IRC) being adopted which have a performance as well as a prescriptive option
- The Conditioned Attic (unvented) has been adopted by the National Codes

The Myth of R-Value

- Increasing R-Value
 - Will not substantially save energy
 - Is not cost effective
 - Does not address condensation issues

Controlling Air Leakage is key

Cost Effective Solution

Soft Foam Insulation – Spray Applied

- Superior Air Leakage control
- Draft free environment
- Helps control condensation / mold
- Significant reduction in energy usage
- Sound Attenuation




**THANK YOU
FOR YOUR TIME**

Questions ?

This concludes the American Institute of Architects
Continuing Education Systems Program

The Icynene Insulation System®

- Flexible, Low Density Foam
- Non-Toxic / No Chemical Emissions
- Effective R-Value / No Voids
- Air Barrier / Pressure Boundary
- Saves 30--50% of Total Heat Loss
- Canadian Advanced Technologies
- 20 Years / 150,000 + Projects
- Spray and Cavity fill formulas
- Sound Attenuation
- Life Time Warranty

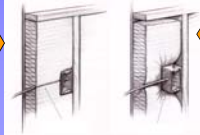


**Incremental changes to R-value
are not an answer**

- Minimal benefit of adding R-Value realized only if insulation is installed perfectly:
 - No gaps, voids, air infiltration
 - No settling over time
- Perfect installation doesn't always happen:

Prescribed Installation

Cut insulation to accommodate wires & junction box, and completely fill the cavity



Field Installation

Compressed insulation and voids create cold spots