

Airtight Buildings
or
Sealed Buildings

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- Benefits of Air Tight Buildings
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Overview

- Controlling air leakage is an important factor effecting:
 - Building's energy efficiency.
 - Occupants comfort.
- Uncontrolled Infiltration of air could have drawbacks such as
 - Increasing energy consumption.
 - Health and safety of the building's occupants.
 - Accelerate deterioration of building materials.
 - Such as concrete corrosion, mold, wet insulation...etc.

Airtightness

- **Airtightness**

Resistance of infiltration/exfiltration of conditioned air through gaps, cracks, openings in the building envelop.

- **Causes of air leaks**

- Pressures difference across the building envelope.
- Temperature difference across the building envelope.

Terminologies

■ Air Leakage

Air leakage refers to the unplanned, unpredictable and unintentional airflow in the buildings (Infiltration) or out of the buildings (exfiltration) through building's envelope.

■ Building Envelope

The building envelope includes all the building components that separate the indoors from the outdoors.

It includes

- Foundation
- Roof
- Windows
- Exterior walls
- doors.

Terminologies

- **Infiltration**

is the movement of air through leaks, cracks, or other adventitious openings **INTO** the building.

Exfiltration

is the movement of air through leaks, cracks, or other adventitious openings **OUTSIDE** the building.

- **Wind Washing**

Air movement that occurs due to wind entering a building envelop and passing through the thermal insulation and significantly impacting the thermal and moisture performance of those assemblies.

Terminologies

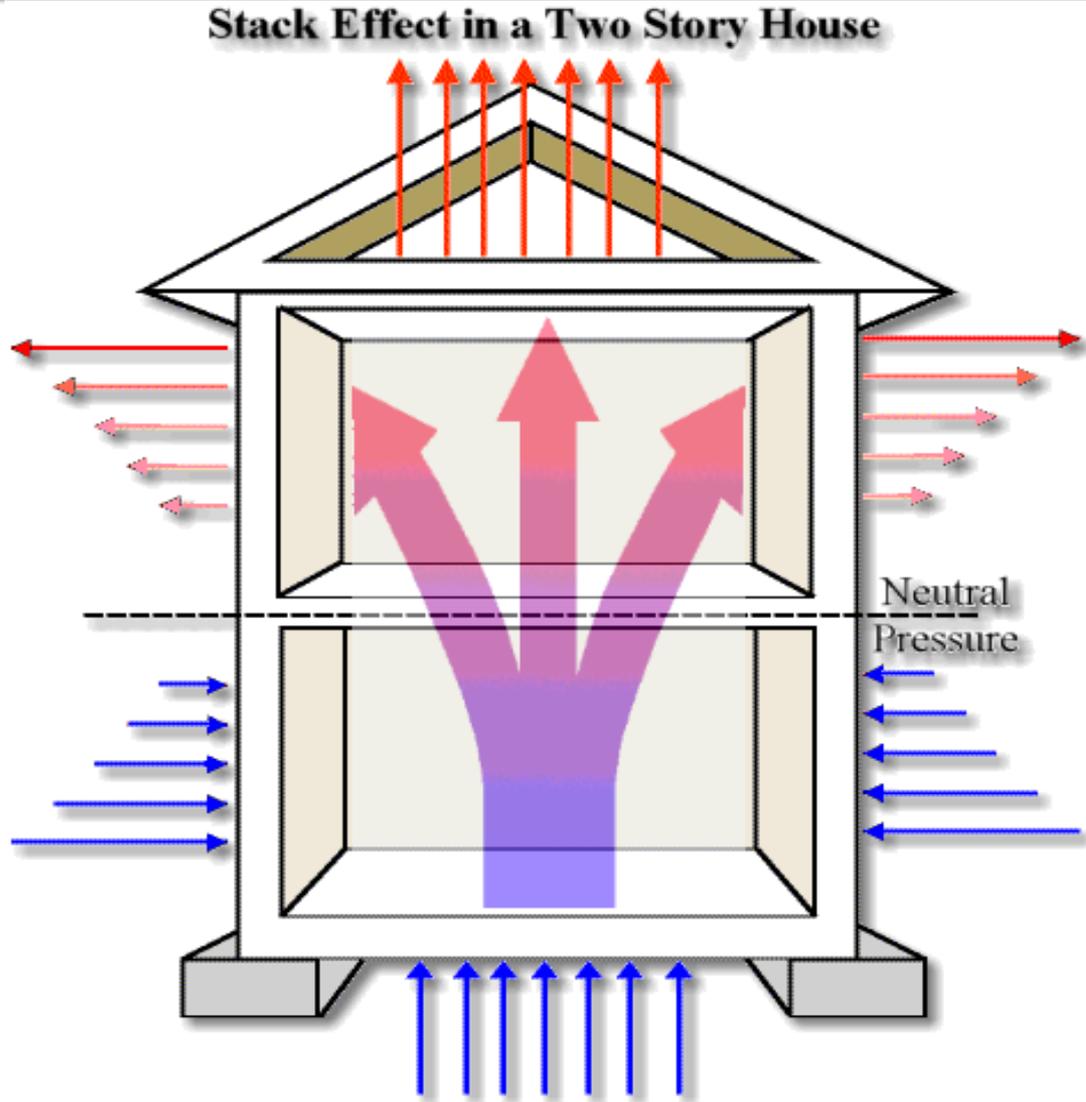
■ Stack Effect

Stack effect is a temperature-driven phenomenon, which is especially noticeable in cold weather, when warmer indoor air, which is lighter than the colder outdoor air, tends to rise in the building.

It is influenced by:

- Temperature differential between indoors and outdoors.
- Size and location of the opening in the building enclosure.

Understanding stack effect

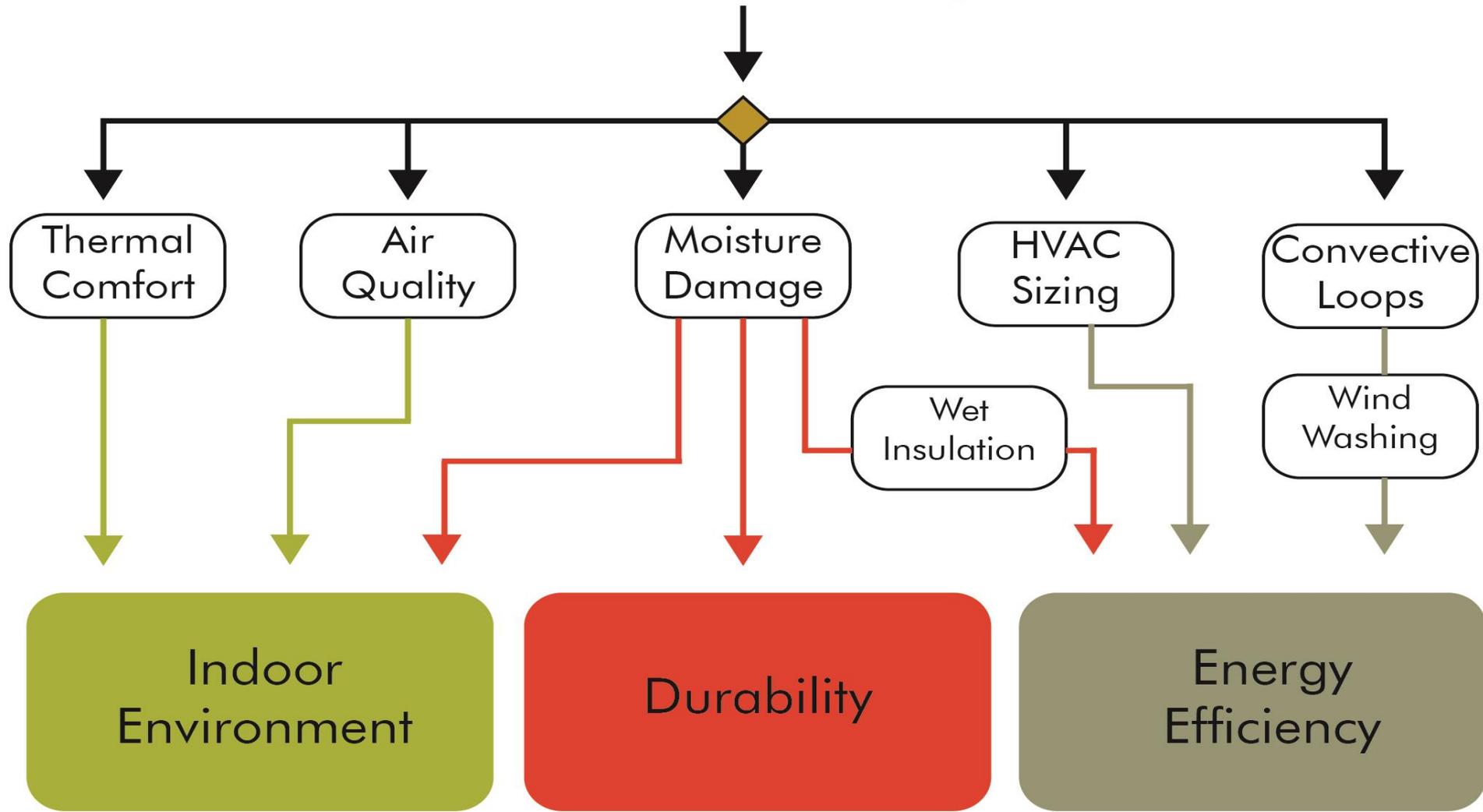


Benefits of Air Tight Buildings

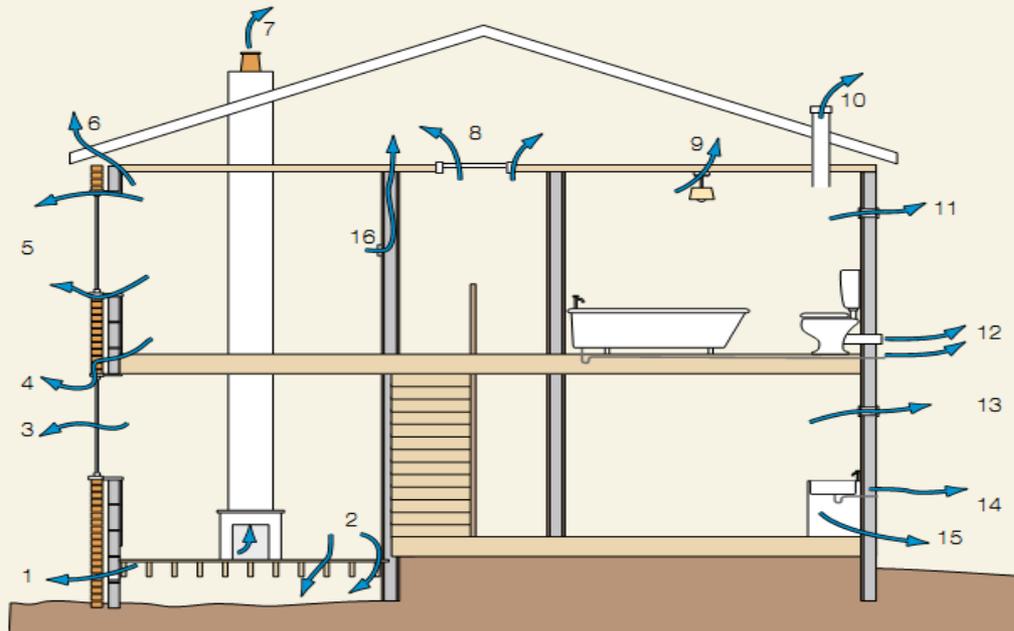
- Air-tight buildings waste less energy, and cause less CO₂
- Enables right-sizing of HVAC system.
- Reduced Energy Costs.
- Vital to achieving '[passive](#)' builds
- Reduced Interstitial Condensation
- More Comfort for Occupants.
- Opportunity for Owners to give their buildings an advantage.

Air leakage Consequences

AIR LEAKAGE CONSEQUENCES



Air leakage paths

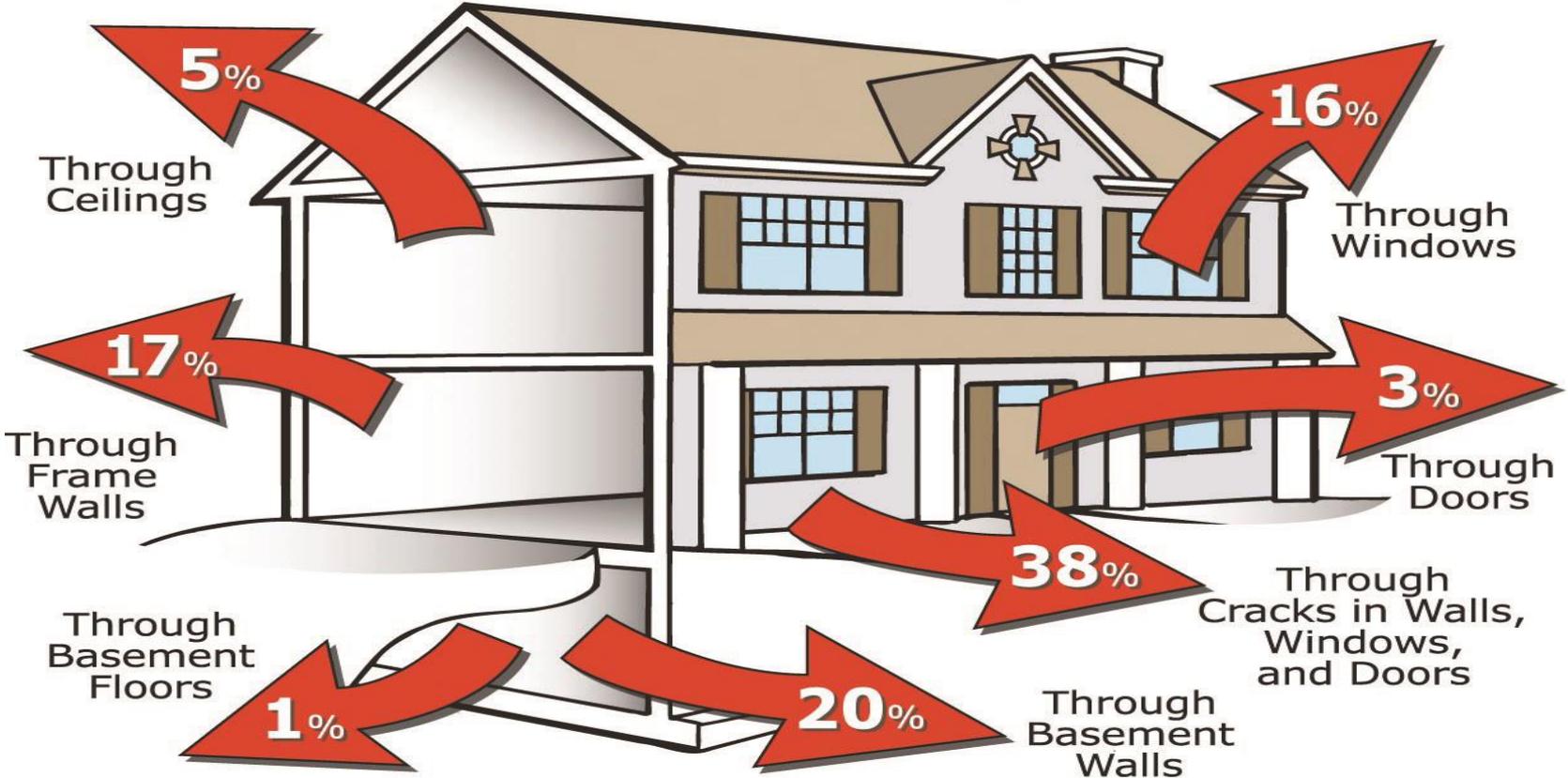


Most common air leakage paths:

- | | | | |
|---|---|----|--|
| 1 | Underfloor ventilator grilles. | 8 | Gaps around loft hatches. |
| 2 | Gaps in and around suspended timber floors. | 9 | Service penetrations through ceilings. |
| 3 | Leaky windows or doors. | 10 | Vents penetrating the ceiling/roof. |
| 4 | Pathways through floor/ceiling voids into cavity walls and then to the outside. | 11 | Bathroom wall vent or extract fan. |
| 5 | Gaps around windows. | 12 | Gaps around bathroom waste pipes. |
| 6 | Gaps at the ceiling-to-wall joint at the eaves. | 13 | Kitchen wall vent or extractor fan. |
| 7 | Open chimneys. | 14 | Gaps around kitchen waste pipes. |
| | | 15 | Gaps around floor-to-wall joints (particularly with timber frame). |
| | | 16 | Gaps in and around electrical fittings in hollow walls. |

Air leakage paths

Air Leakage



*Drawing courtesy of
Touch 'n Foam Insulating Sealants*

Improving Airtightness

- **Design a tight building.**
 - Material type.
 - Building orientation.
 - Opening sizes.
 - Install airtight layer.
 - Pressurization.
- **Construct a tight building.**
 - Pipe and duct penetrations.
 - Opening's sealant.
 - Wall's joints.
 - Use sealant for openings and penetrations.

Airtightness Test

- Smoke pencil
- Theatrical fog
- Infrared thermography

Airtightness Test

Smoke Pencil



Airtightness Test

Identification of leakage pathways using theatrical fog



Airtightness Test

Exterior infrared thermography is conducted early morning or late evening when inside and outside temperature differences are greatest.



Infrared thermography

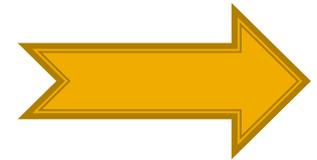
Airtightness in the Buildings

Discussion

Passive Builds

- ***Passive House***

Is the house which is built to be extremely energy efficient, and has a comfortable interior climate maintained without a traditional heating system - or active cooling.



Convective Loop

Convective loops can form within highly air permeable insulation (low-density fibrous insulations) or small gaps around insulation.

