abaa 2025 building enclosure conference

Moisture Defects in Buildings: A SICK BUILDING EPIDEMIC

Cheryl Ciecko, Architect, FALA, LEED AP

Dwell Well Institute

AIA Continuing Education Provider

abaa EDUCATION

Moisture Defects: A SICK BUILDING EPIDEMIC

Poor air quality caused by water damage and mold is contributing to increasing health burdens on occupants of buildings…

Professionals and non-professionals alike will gain knowledge and insights to discover, correct and **avoid building defects, errors and omissions that often lead to water damage**, high indoor humidity, mold and poor indoor air quality to confidently build facilities which are durable as well as being wellness supporting environments.

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CHERYL CIECKO, FALA, LEED AP
Architect

Licensed architect, building science, and healthy building consultant providing education and resources to professionals and individuals worldwide.

Mission: Create awareness &education to prevent building defects that lead buildings that make occupants sick.

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Learning Objectives

1. Recognize causes and sources of water accumulation in building materials with potential health impacts.
2. Evaluate the impacts of moisture on all building materials
3. Consider the mechanics of moisture movement for building design.
4. Recognize moisture related building defects and design solutions to avoid them.

Moisture Defects:
A SICK BUILDING EPIDEMIC

Poor air quality caused by water damage and mold is contributing to increasing health burdens on occupants of buildings…Understanding and applying building science fundamentals along with considerations uniquely related to region, site, structure type, materials and construction coordination is the key to successful building solutions that will be durable and supportive of occupant wellness over time.

Despite building code requirements, common building defects continue to be overlooked in the quest for sustainability, but at the expense of durability and occupant wellness.

Professionals and non-professionals alike will gain knowledge and insights to discover, correct and **avoid building defects, errors and omissions that often lead to water damage**, high indoor humidity, mold and poor indoor air quality to confidently build facilities which are durable as well as being wellness supporting environments.

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Objectives

1. Recognize Causes & Sources of Mold…Affect Health
2. Impacts of Moisture on Materials
3. Mechanics of Moisture Movement
4. Review of Defects & Solutions

CHERYL CIECKO FALA, LEED AP

- Licensed Architect – 35+ years
  - B.S. Architecture
  - Master Architecture
- Senior Technical Director – Wood Industry
- American Lumber Standards Committee
- Mom of 4
- Research Toxin Exposure - 20+ years
- Started www.avoidingmold.com in 2016
- Autoimmune Diseases /Lyme
- **Thriving…**

INTRODUCTIONS

- Building Construction Industry
- Architects
- Engineers
- Building/Mold Inspectors
- Remediators
- Moisture problem in a building?
- Experienced environmental health impacts?

2005

Lessons - Toxins are Everywhere

Food
Water
EMFs
VOCs
Artificial Light
Chemicals
Cleaning Products
Radon
Air Fresheners

Heavy Metals
Pesticides
Ticks/Mosquitos
Parasites
Antibiotics/ Vaccines
Health supplements
Personal Products

AIR WE BREATHE

Objectives

1. **Recognize Causes & Sources of Mold...Affecting Health**
2. Impacts of moisture on materials
3. Mechanics of moisture movement
4. Review of defects/solutions

Building Mold…

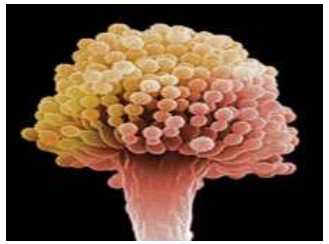
Bacteria comes with mold …

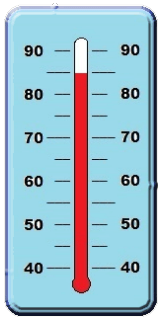
1. Completely concealed/hidden
2. Undetectable with the naked eye
3. Can have no noticeable smell
4. Smells can vary
5. Color and texture can vary
6. Can be missed by testing
7. Toxic dead or alive

http://www.fsec.ucf.edu/en/consumer/buildings/basics/moldgrowth.htm

Conditions for Mold Growth?

1. Mold/Fungus Spores
2. Oxygen
3. Temperature of 30-130 F
   (most common 40-105 F)
4. **Nutrient Source**
5. **Moisture**





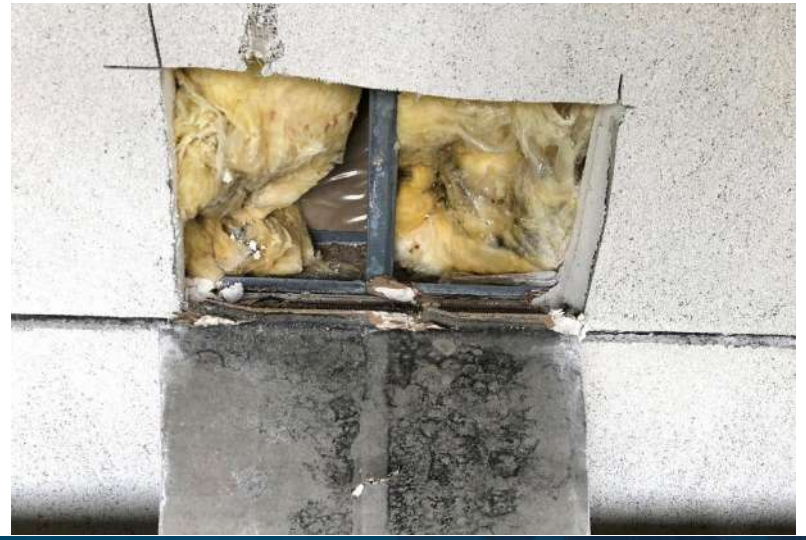
Objectives

1. Recognize causes & sources of mold...affecting health
2. **Impacts of Moisture & Mold on Materials**
3. Mechanics of moisture movement
4. Review of defects/solutions

Materials & Moisture

NO structural material is immune to moisture damage.

NO Material Exempt From MOLD…



Moisture + *Dust/Dirt* = Mold

Condensation due to high humidity.

Stop Mold by Eliminating the Food Source?

Mold Proof Materials / Mold Resistant Materials

Check the Warranty

- ***Limitations***
- ***Exclusions***
  - ***Water***
  - ***Dirt/dust***
  - ***High Humidity***
- **Installation Instructions-** ‘Clean/Dry’
- **Remedy**

Plumbing Leak

Reasons Buildings Have Mold

1. Unintended consequences
2. All buildings are COMPLICATED
3. Designed, built by HUMANS
4. Qualified ARCHITECTS & other building professionals are NOT involved in home building
5. Qualified Contractors in short supply
6. Building Codes are overlooked
7. Quality work costs Money

A seventh child who contracted a mold infection at Seattle Children's Hospital has died

By Nicole Chavez and Rebekah Riess, CNN

Updated 6:15 AM ET, Fri February 14, 2020

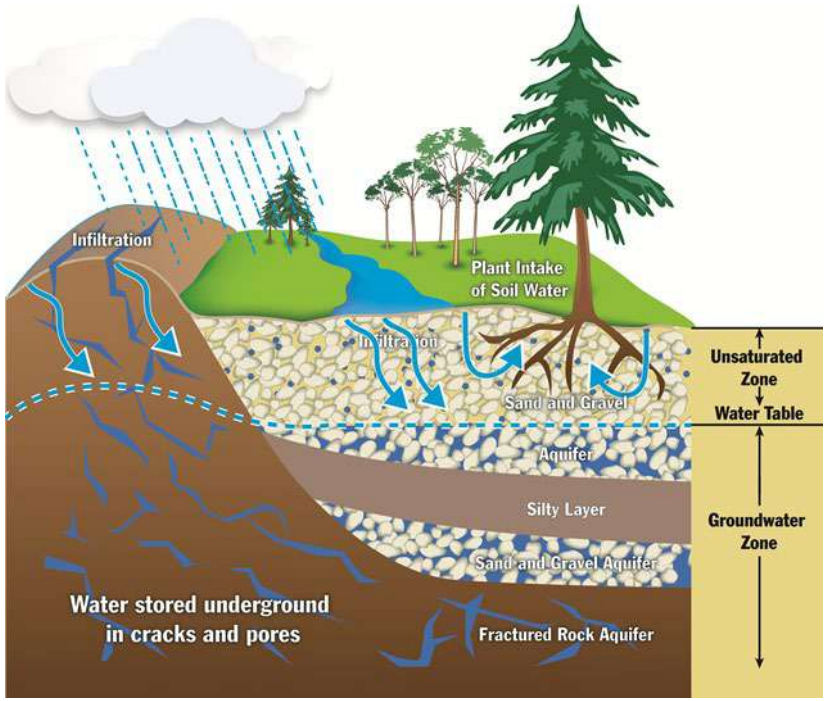
Objectives

1. Recognize causes & sources of mold...affecting health
2. Impacts of moisture on materials
3. **Mechanics of Moisture Movement**
4. Review of defects/solutions

Moisture Sources

Exterior:

- Precipitation
- irrigation systems
- water vapor
- groundwater
- Gutters & Downspouts
- Omitted/Poor Flashing



Moisture Sources

Construction Moisture:

- Concrete
- Masonry & brick
- Grout / Mortar for tile
- Wood materials
- Drywall tape
- Paint

Moisture Sources

Interior:

- Building occupants
- Activities

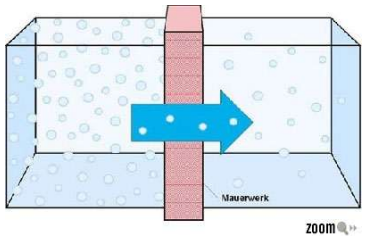
Moisture Transport Mechanisms

1. Liquid flow
2. Capillary Action
3. Air Movement
4. Diffusion







1. Moisture – Liquid Flow

Bulk Water

Movement of water under the ***influence of a driving force***

- Gravity
- Suction caused by **air pressure differences**

Installation Defects

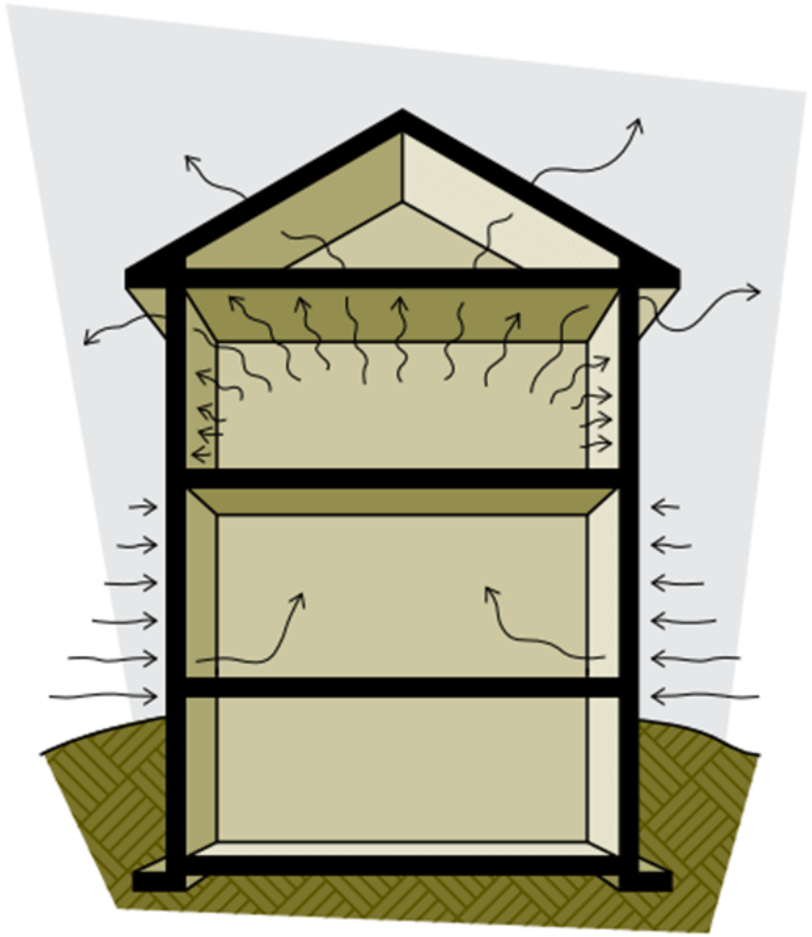
New Construction Home 2025

5 year old High-End Condo Building

Copeland Building Envelope Consulting, Inc.

Air Pressure Differentials are Complicated

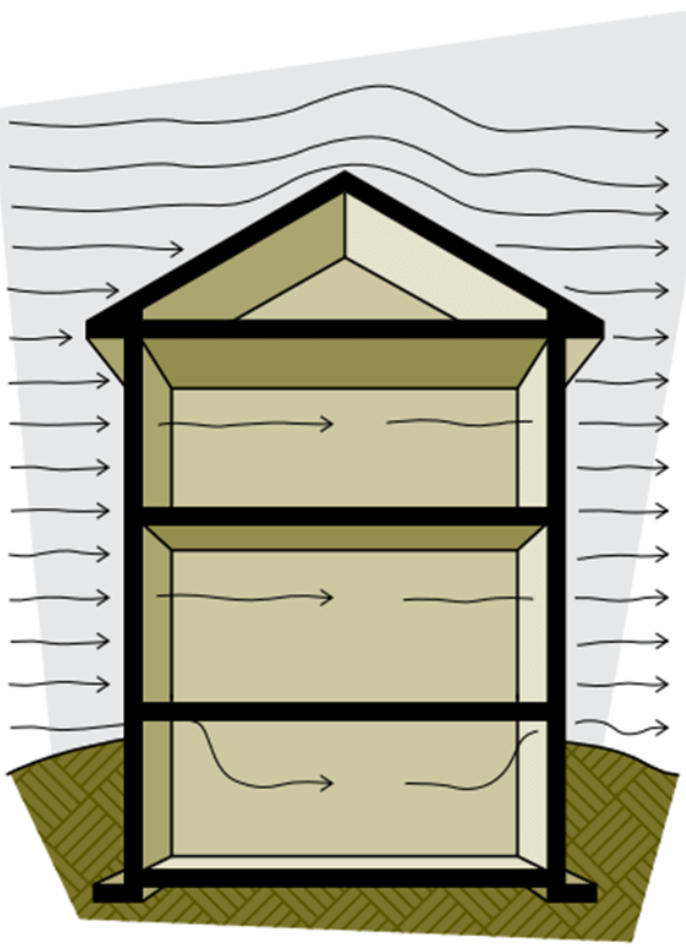
- Air movement caused by thermal differences
- Warmer air less dense than cooler air
- Warm air rises – pressure differences
- Cooler air from outside is draw into lower floors



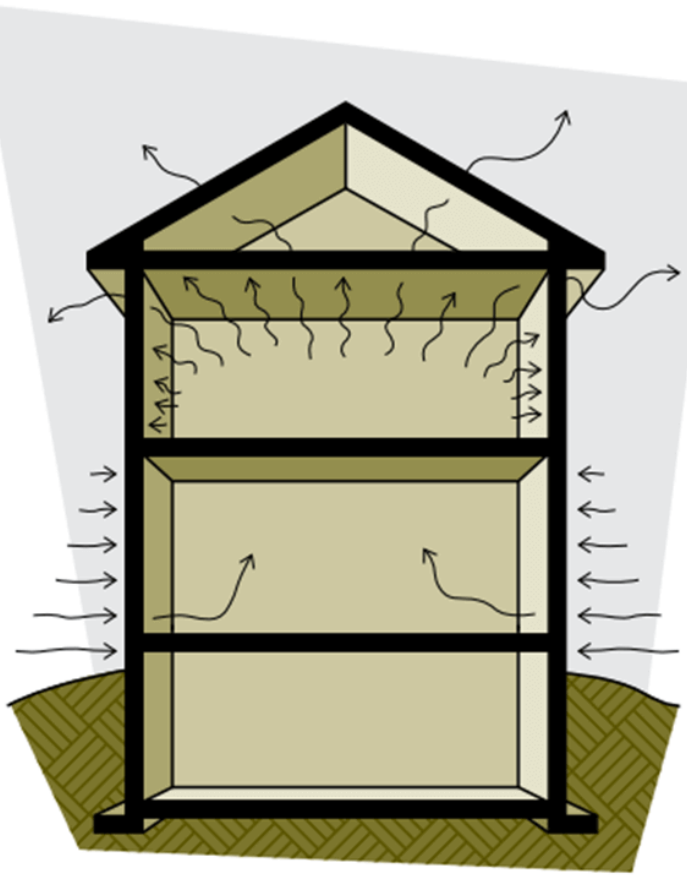
Stack effect

- With warm temperatures – the stack effect is reversed
- Hot air enters the upper portion of a cooler building
- Down draft is created.

Air Pressure Differentials are Complicated

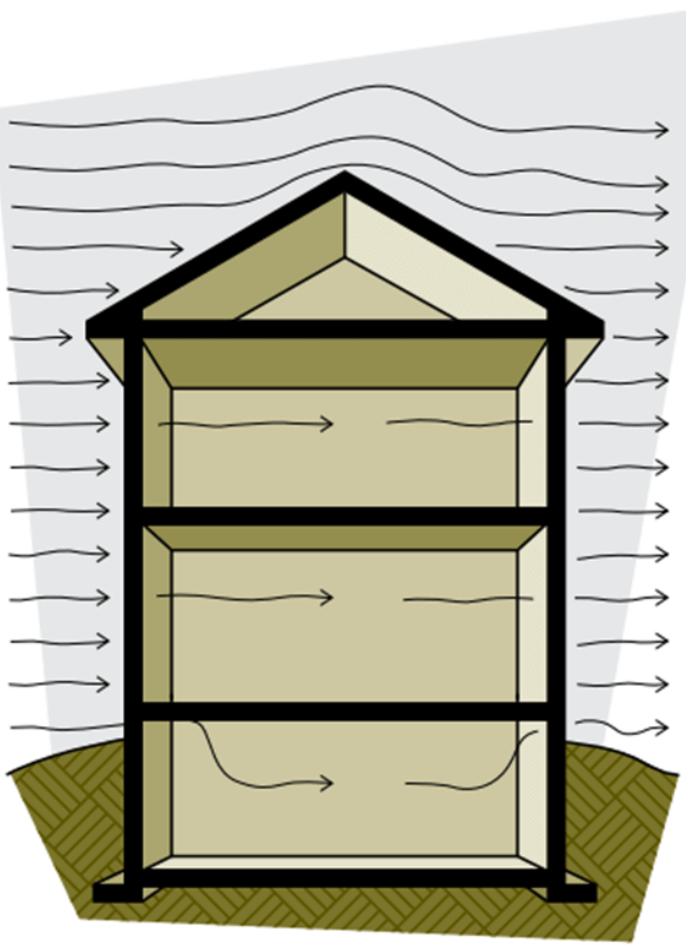


Wind effect



Stack effect

Air Pressure Differentials are Complicated



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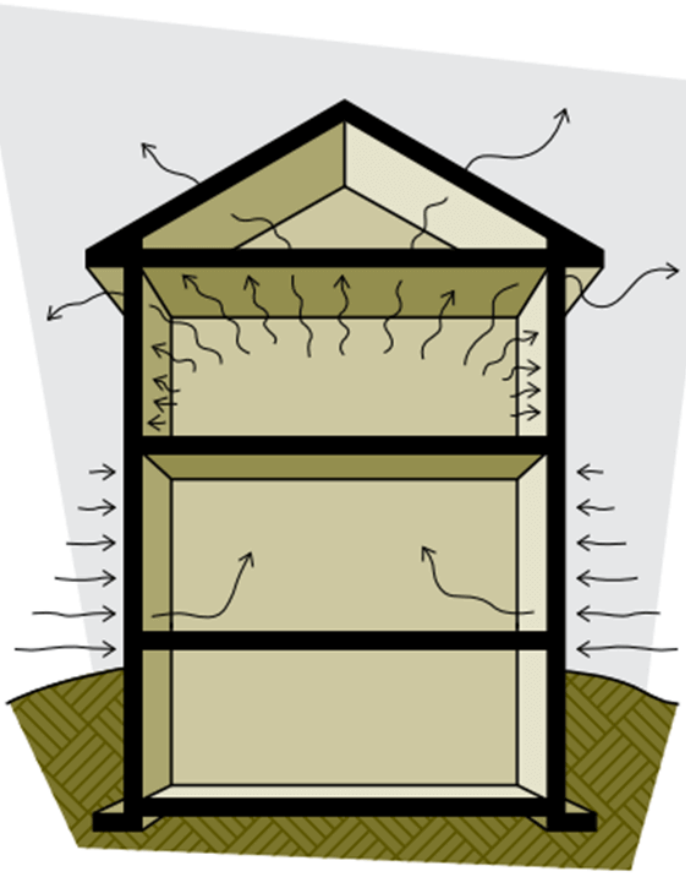
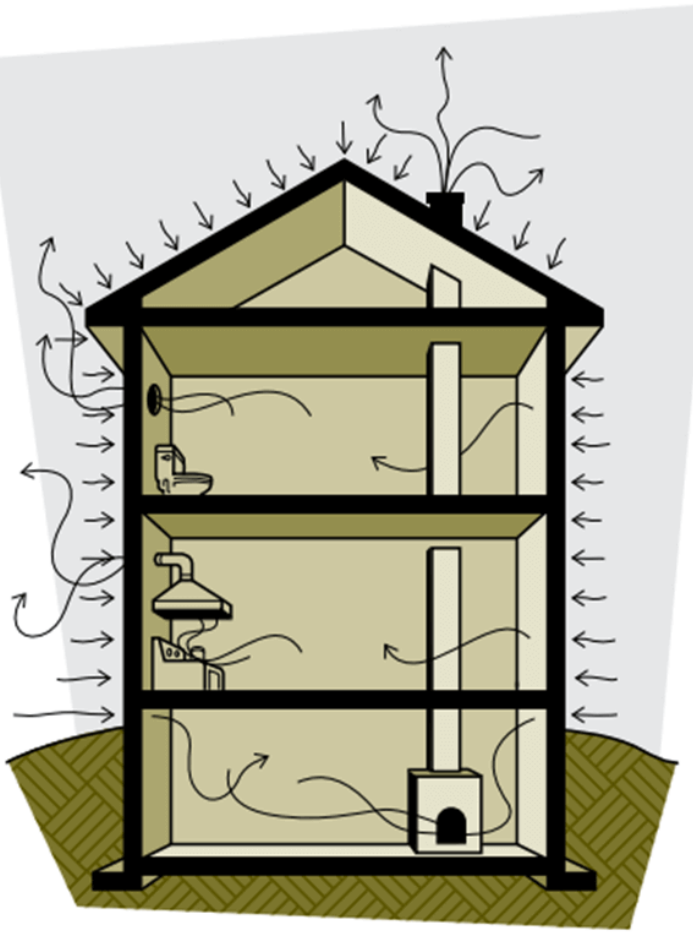


Stack effect

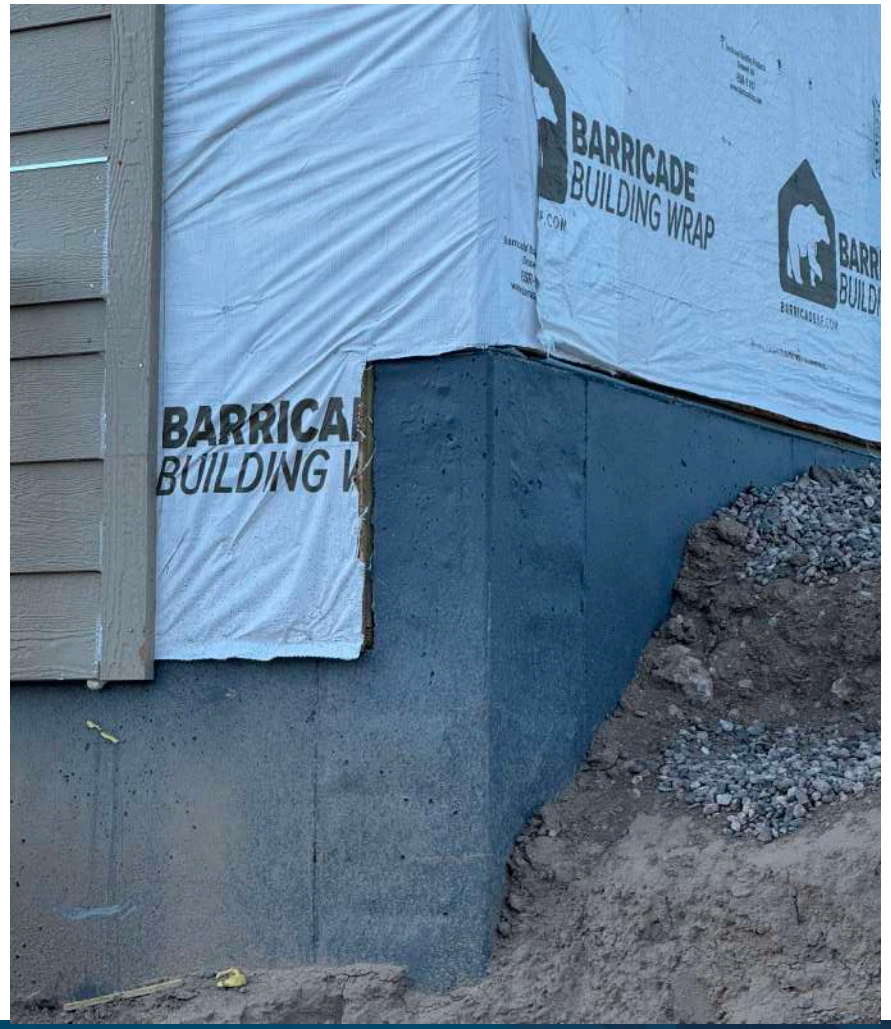


Combustion and ventilation effect

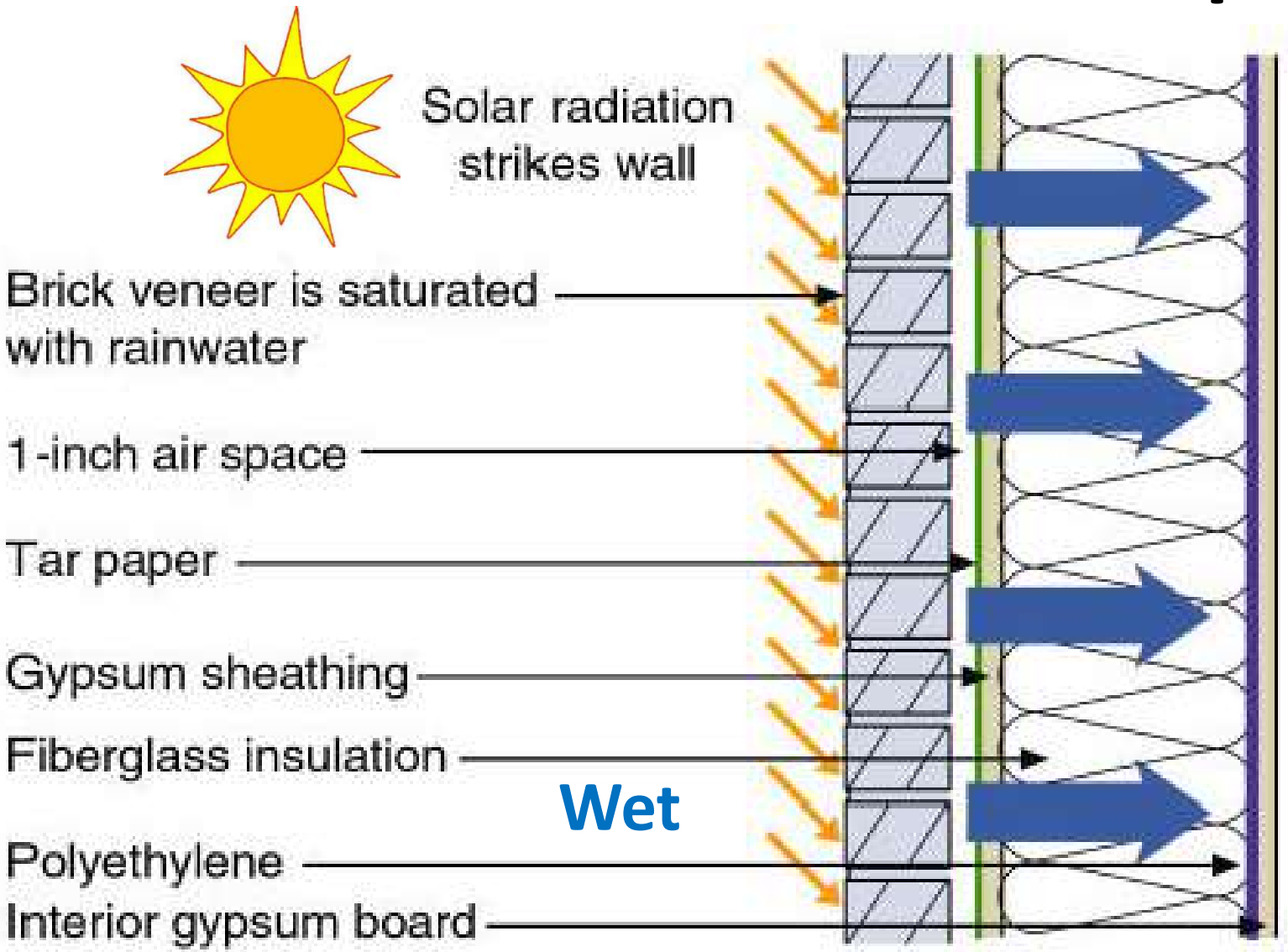
2. Moisture – Capillary Action

- Movement of water in **porous materials** resulting from ***surface tension forces.***
- Suction in the small space created between two materials.
- ‘Rising Damp’

Capillary Action Locations



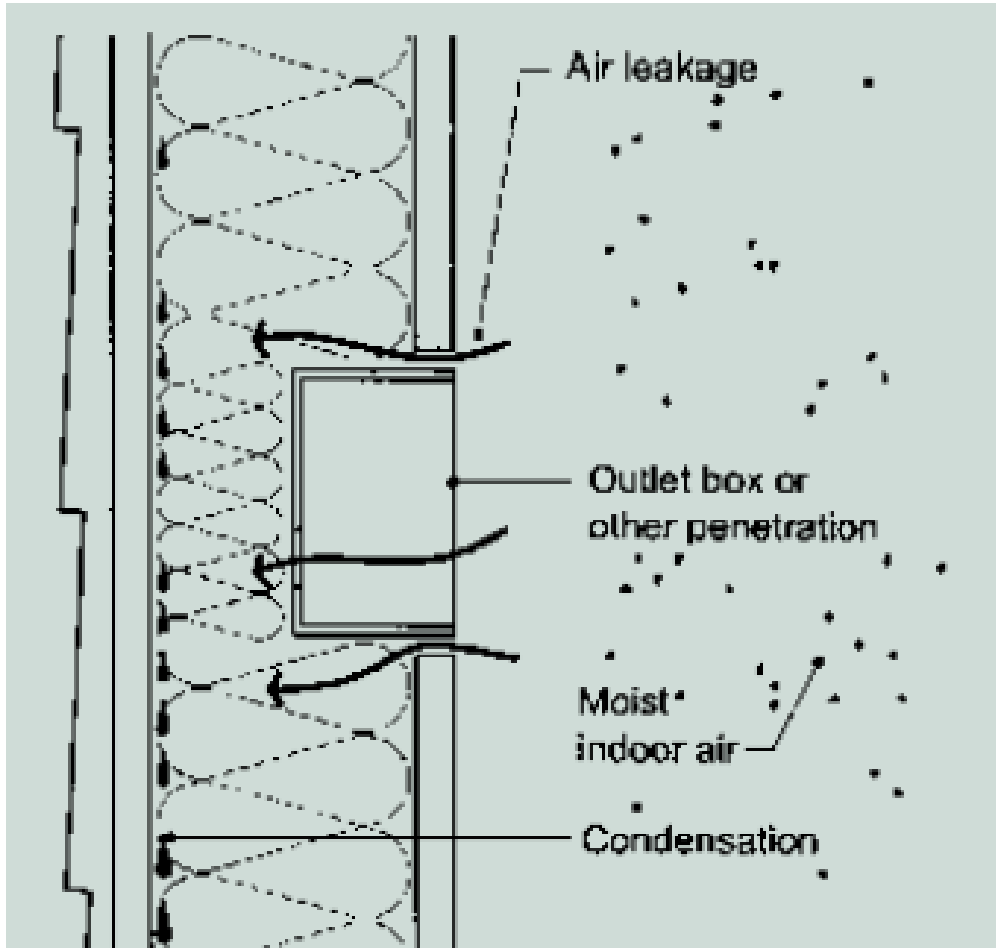
Inward Moisture Drive - Wallpaper Vapor Barrier



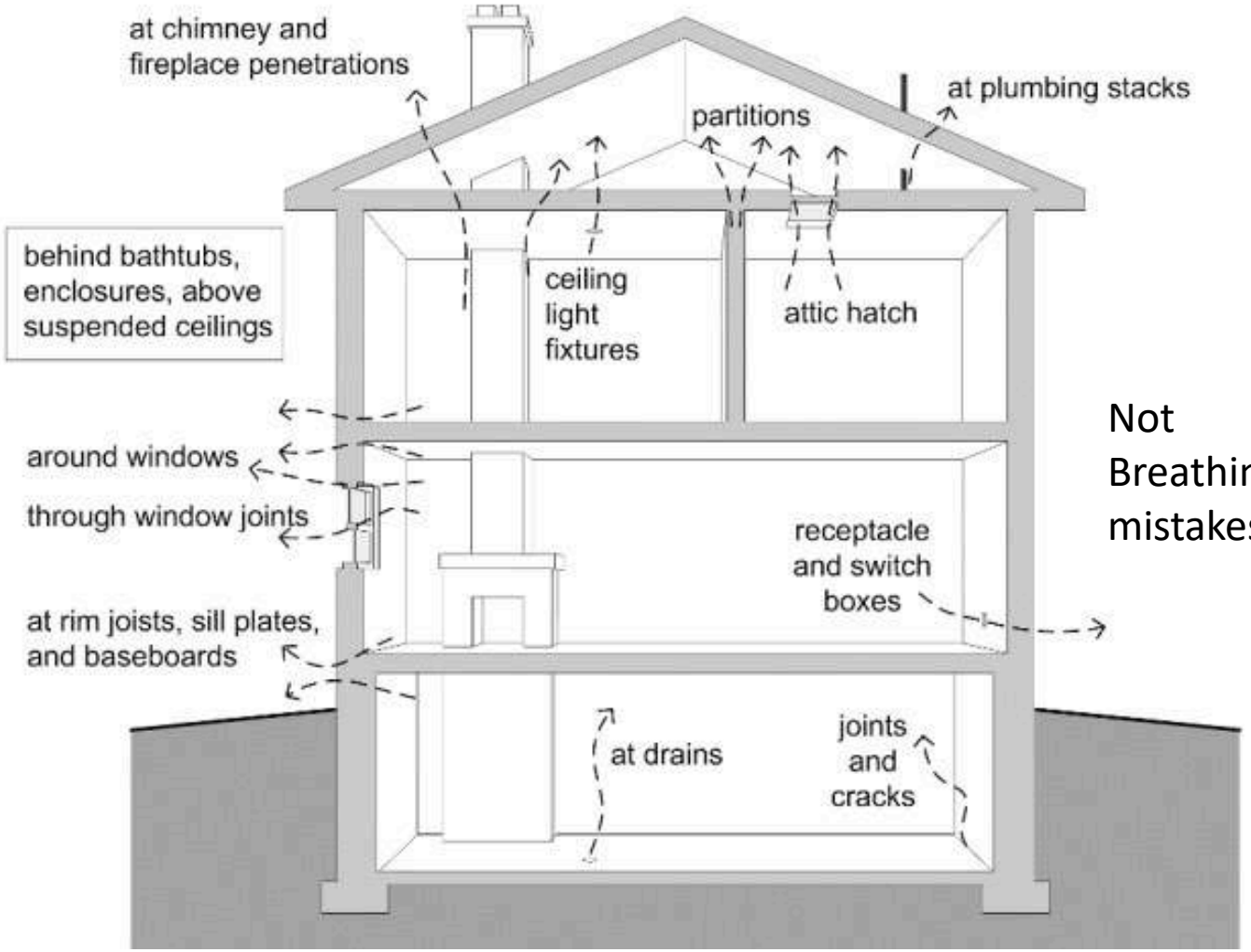
Dry

3. Moisture – Air Movement

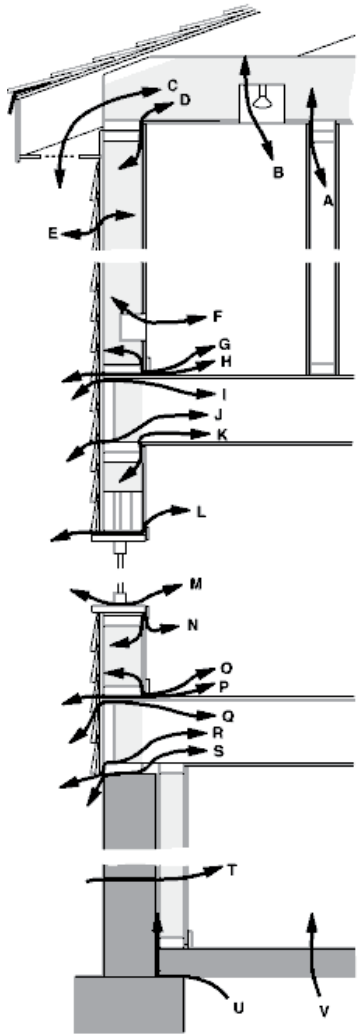
- Movement of ***water vapor*** from ***from air flow*** thru spaces & materials.



Air Pressure Movement



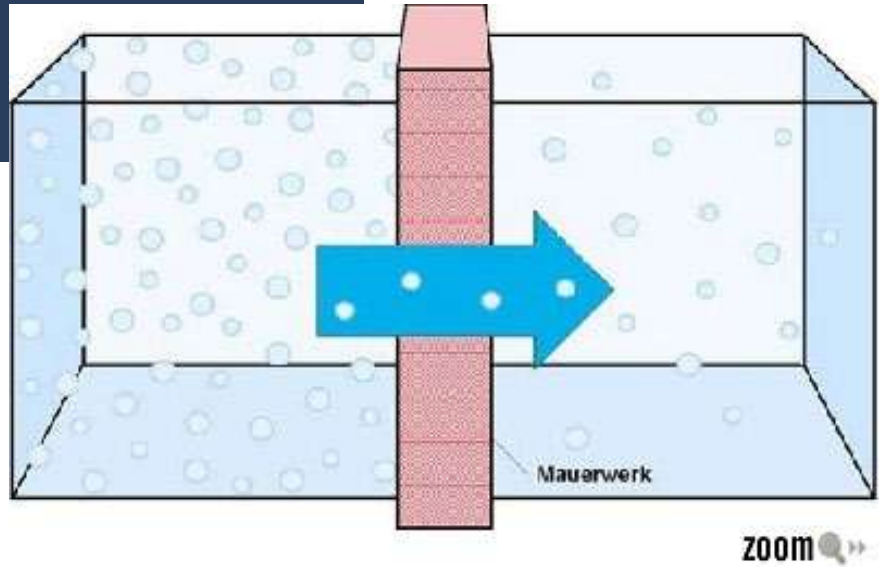
Not Breathing…these are mistakes

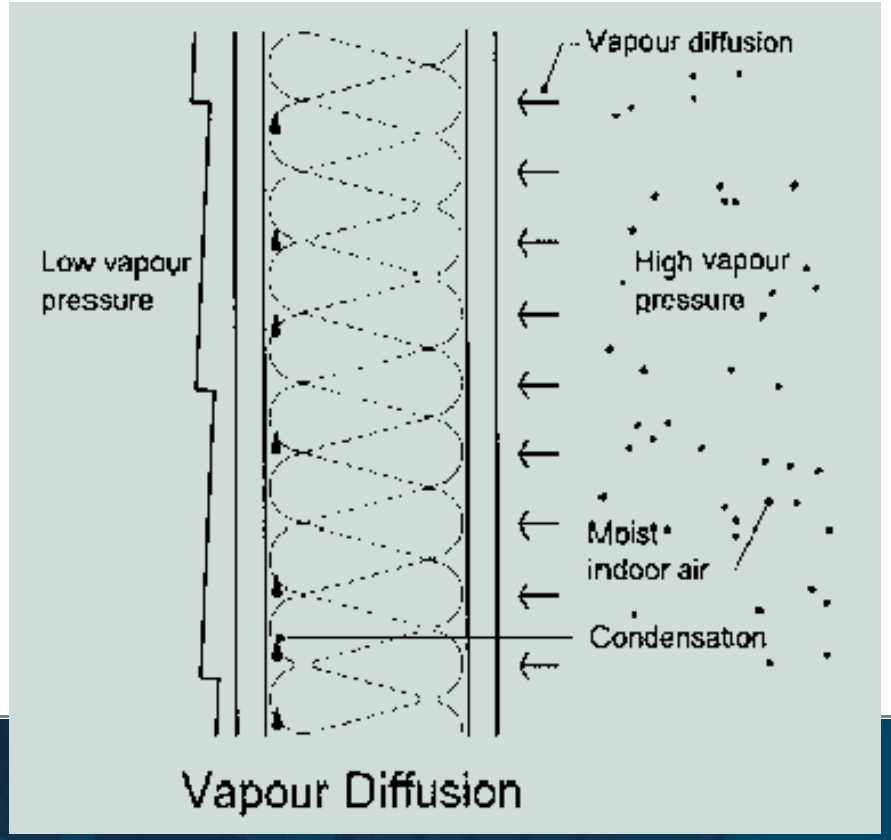


https://buildingscience.com/sites/default/files/migrate/pdf/BSD-014_Air%20Flow%20Control_ed.pdf

4. Moisture - Diffusion

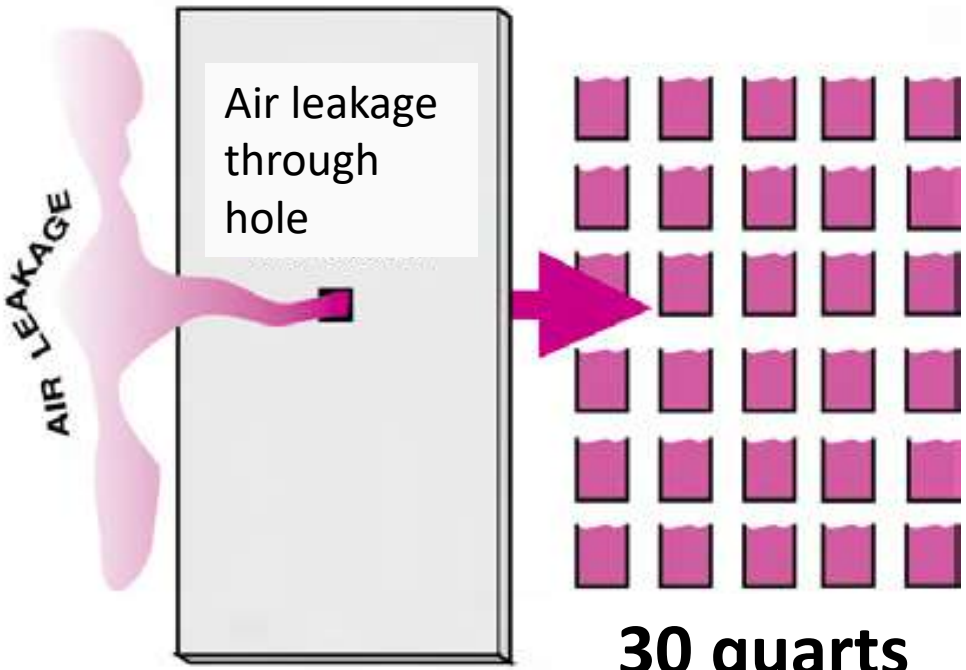
- Movement of water vapor resulting from a ***vapor pressure difference***.
- Through the materials





Moisture Transport Comparison

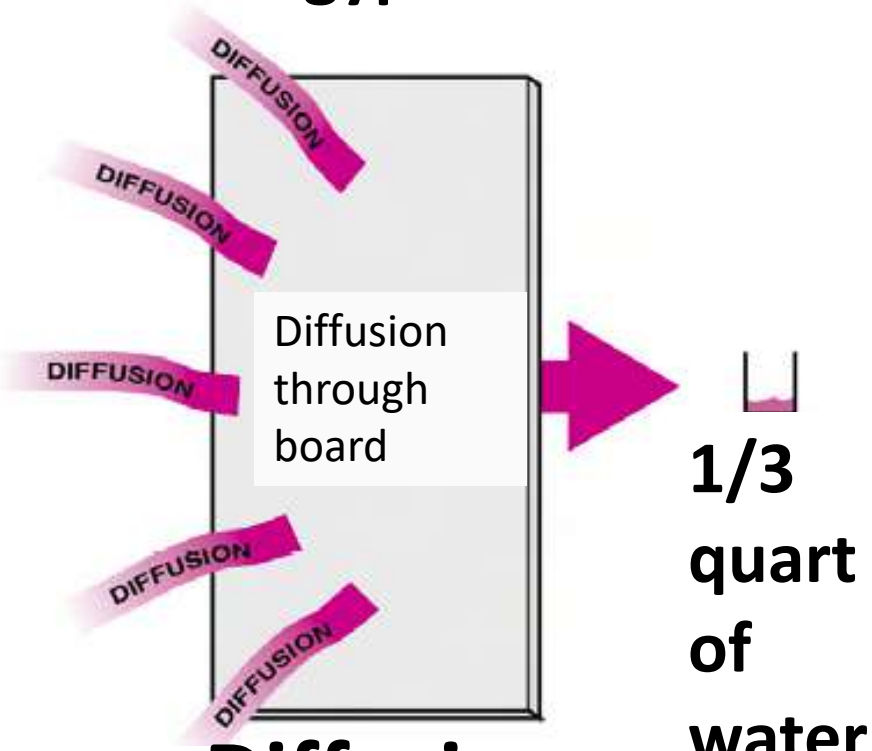
4 x 8 sheet of gypsum board w/ 1 in sq. hole



Air Leakage

30 quarts of water

4 x 8 sheet of gypsum board



Diffusion

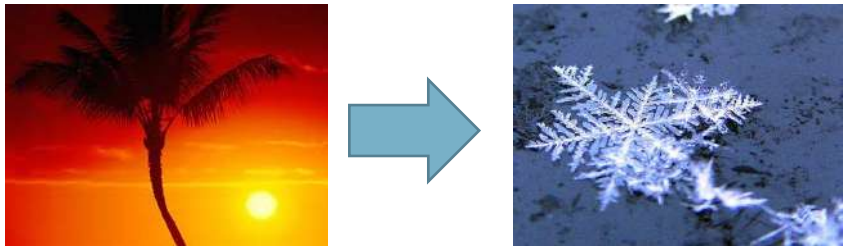
1/3 quart of water

Interior temp. 70F, 40% RH

Source: Buildingscience.com

Building Science Fundamentals

- **Heat** moves from



- **Moisture** moves from

- Buildings dry more to the ***inside*** during **warm, humid weather**
- Building dry more to the ***outside*** during **cold, dry weather**

Objectives

1. Recognize causes & sources of mold
2. Impacts of moisture on materials
3. **Mechanics of moisture movement**
4. **Review of DEFECTS & SOLUTIONS**

Common Building Defects / Solutions

1. **Drainage**
2. Deflection
3. Drying
4. Details

Health impacts growing…
Attorney specialists in Building/Construction Defects growing…

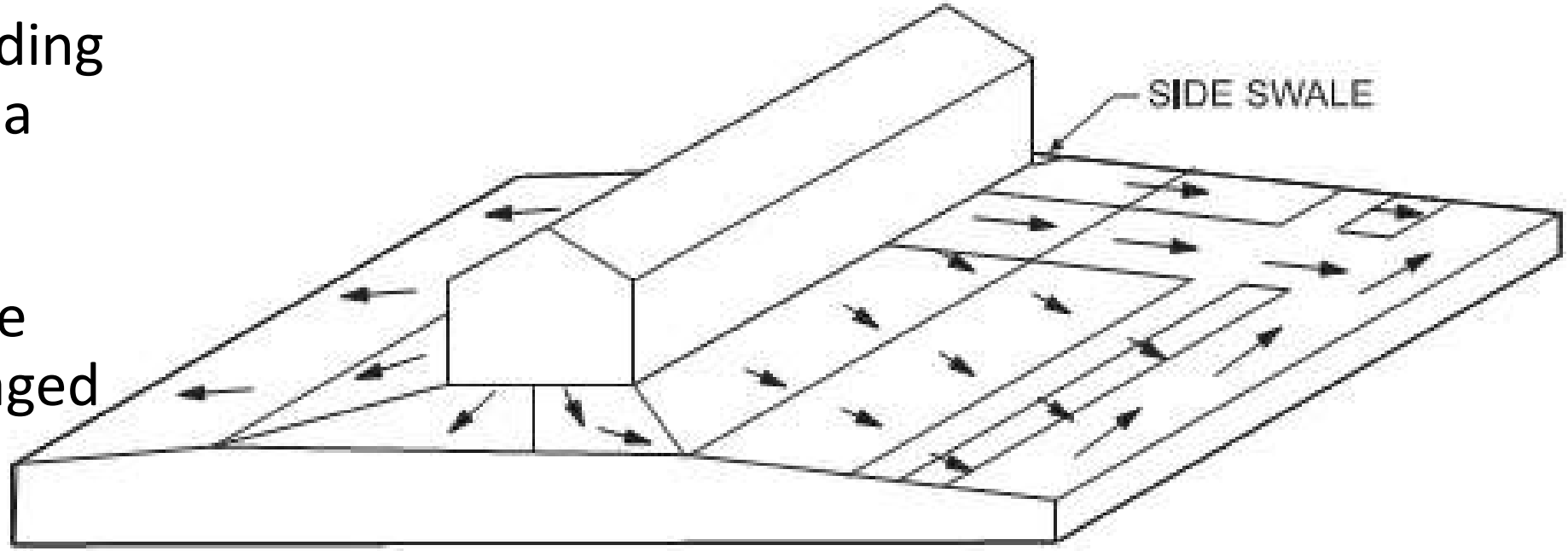
SITE DESIGN - Ensure Proper Drainage Away

R401.3 Drainage

The slope away required to be 6 inches...within the first 10 feet. (5%)

Paved areas including patios must have a 2% slope.

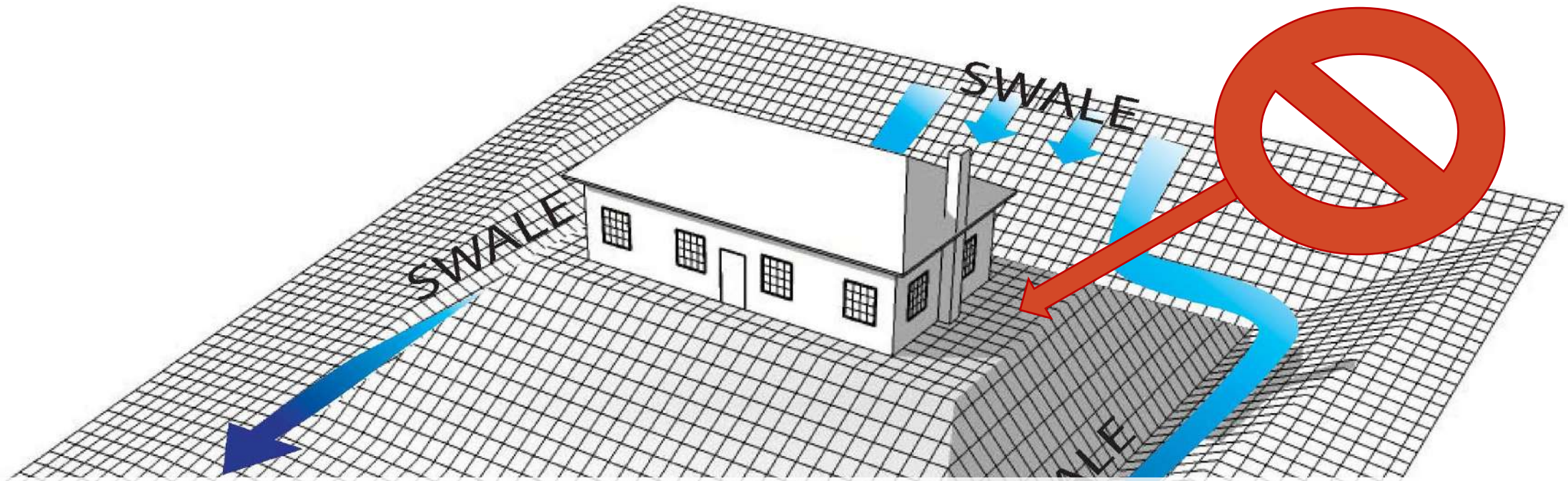
Exceptions require water to be managed alternatively.



GRADING METHOD FOR LOT WHERE DWELLING IS LOCATED ON A RIDGE.
DRAINAGE SWALES ARE LOCATED AT SIDE YARDS IN AREA OF POSITIVE SLOPES.

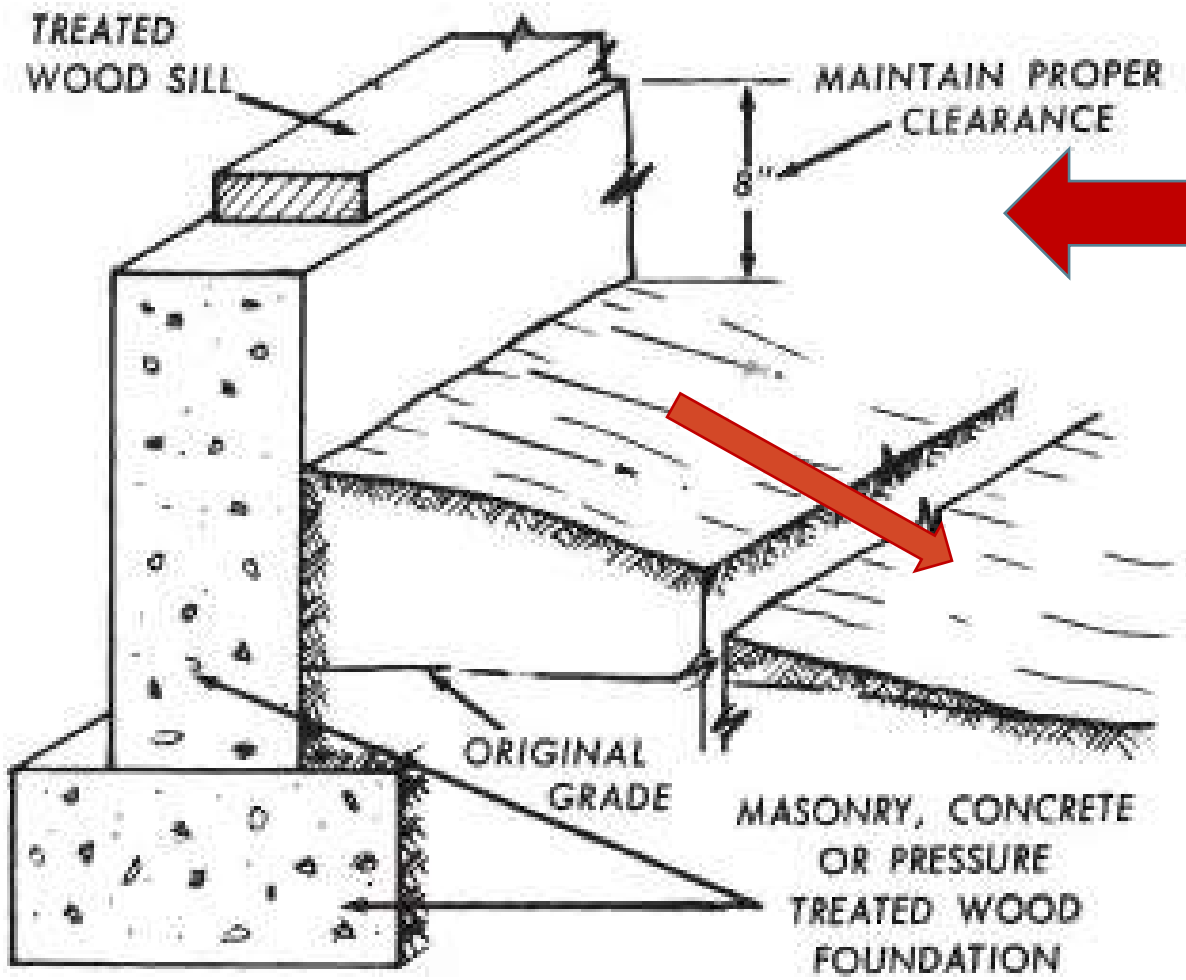
https://codes.iccsafe.org/s/IRC2015/part-iii-building-planning-and-construction/IRC2015-Pt03-Ch04-SecR401.3

Drain Around Structures With Swales



- Slope starts at the foundation.
- Avoid flat or low sloped areas adjacent to foundations.
- Check landscaping plans to maintain clearances and slope of subgrade, as well as any finish ground cover.
- Avoid plantings & sprinkler systems adjacent to foundations

Maintain Clearances From Soil



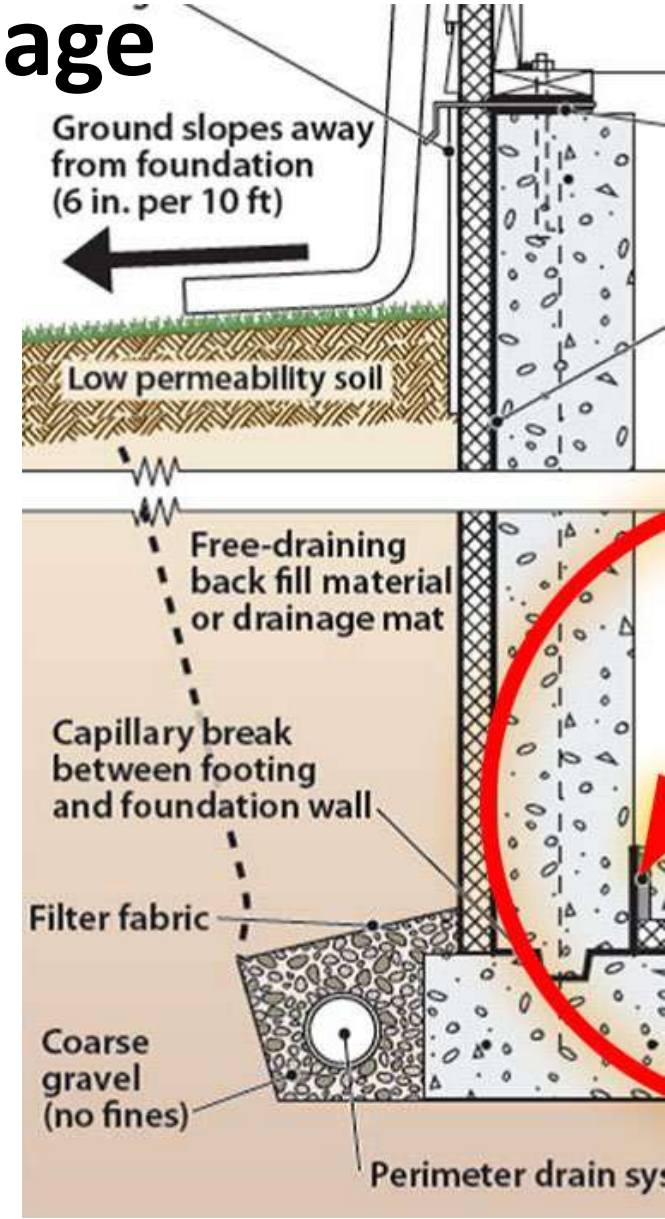
1. Maintain proper clearance from soil - 8 inches

2. Drain away water - 5% slope
3. Compacted, impermeable soil

IRC Figure R317.1(1)

Attention to SITE DESIGN - Proper Drainage

- **5% Slope w/low permeability, compacted soil** - Fully compacted areas adjacent to the foundation to promote drainage away.

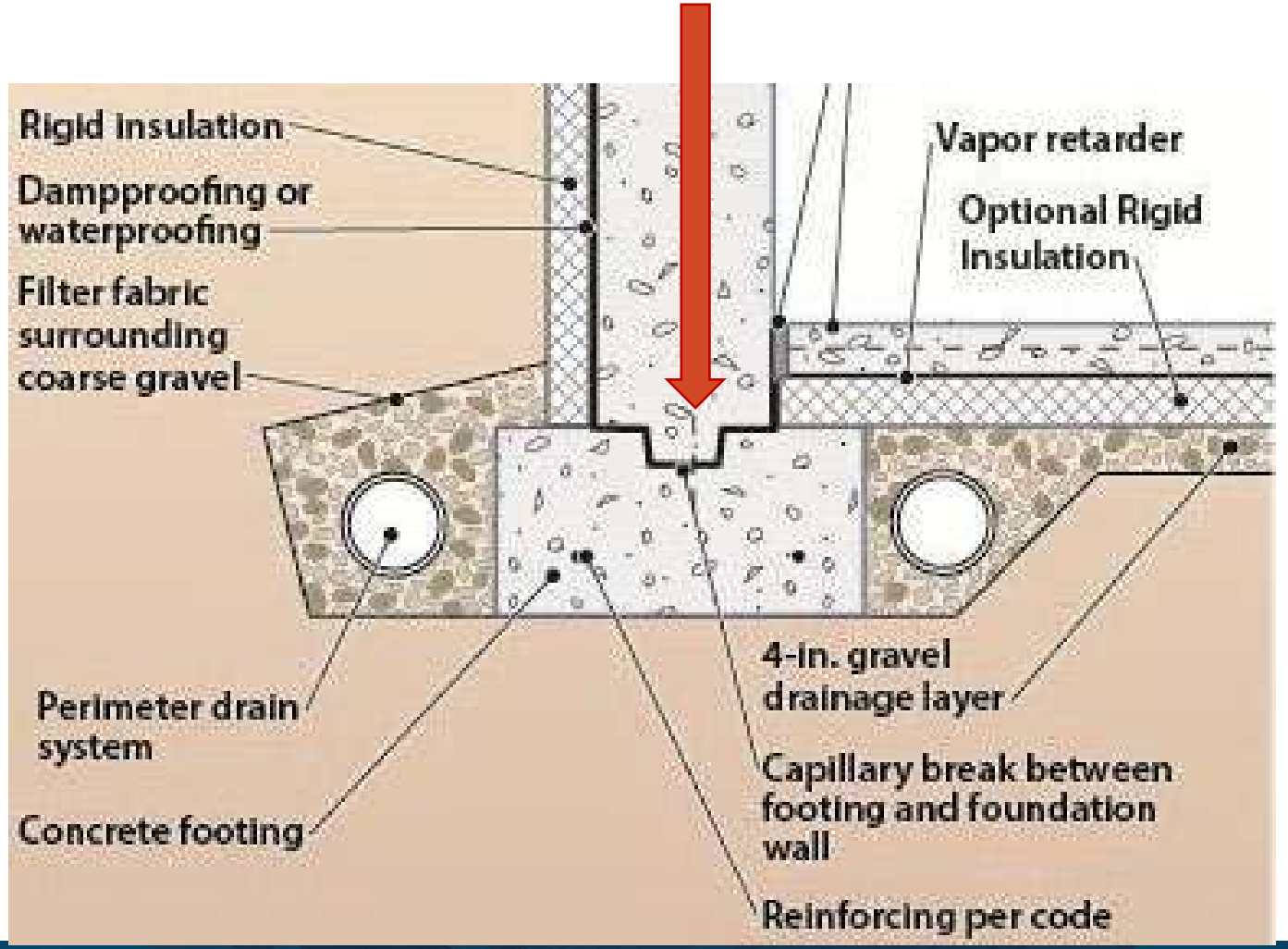


- Free drainage back fill material or a drainage mat to be used BELOW the low perm compacted & sloped soil.
- Use filter fabric as necessary.

https://basc.pnnl.gov/resource-guides/final-grade-slopes-away-foundation#edit-group-description

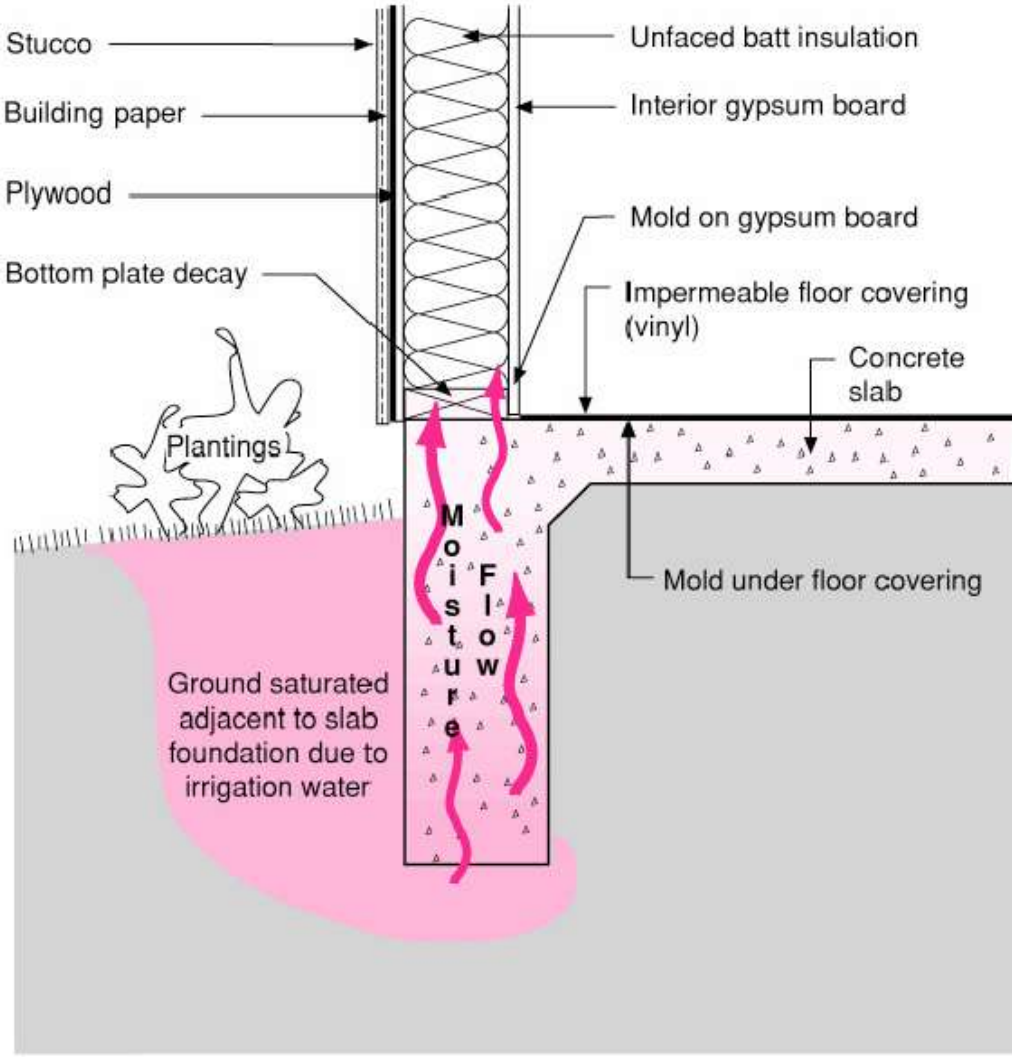
Capillary Break - Footing/Foundation Wall

- Site drainage away
- Exterior waterproofing
- **Capillary break between footing & foundation wall**
- Min. 10mil vapor barrier
- Capillary Break / course gravel
- Vapor barrier attached to all openings & walls up 6 “ approx.
- Insulation between slab & foundation wall



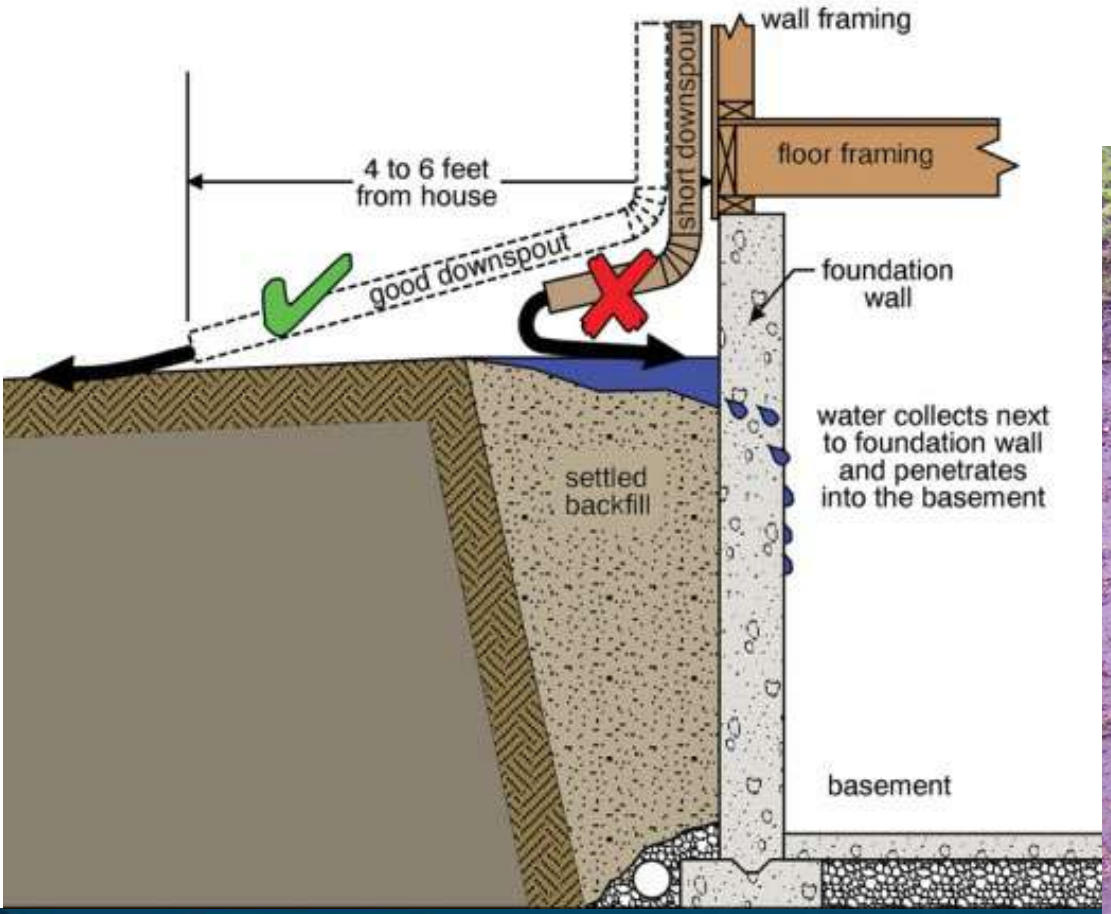
https://foundationhandbook.ornl.gov/handbook/section2-2.shtml

Slab Edge Capillarity



http://buildingscience.com/documents/digests/bsd-108-investigating-and-diagnosing-moisture-problems

Extend Downspouts



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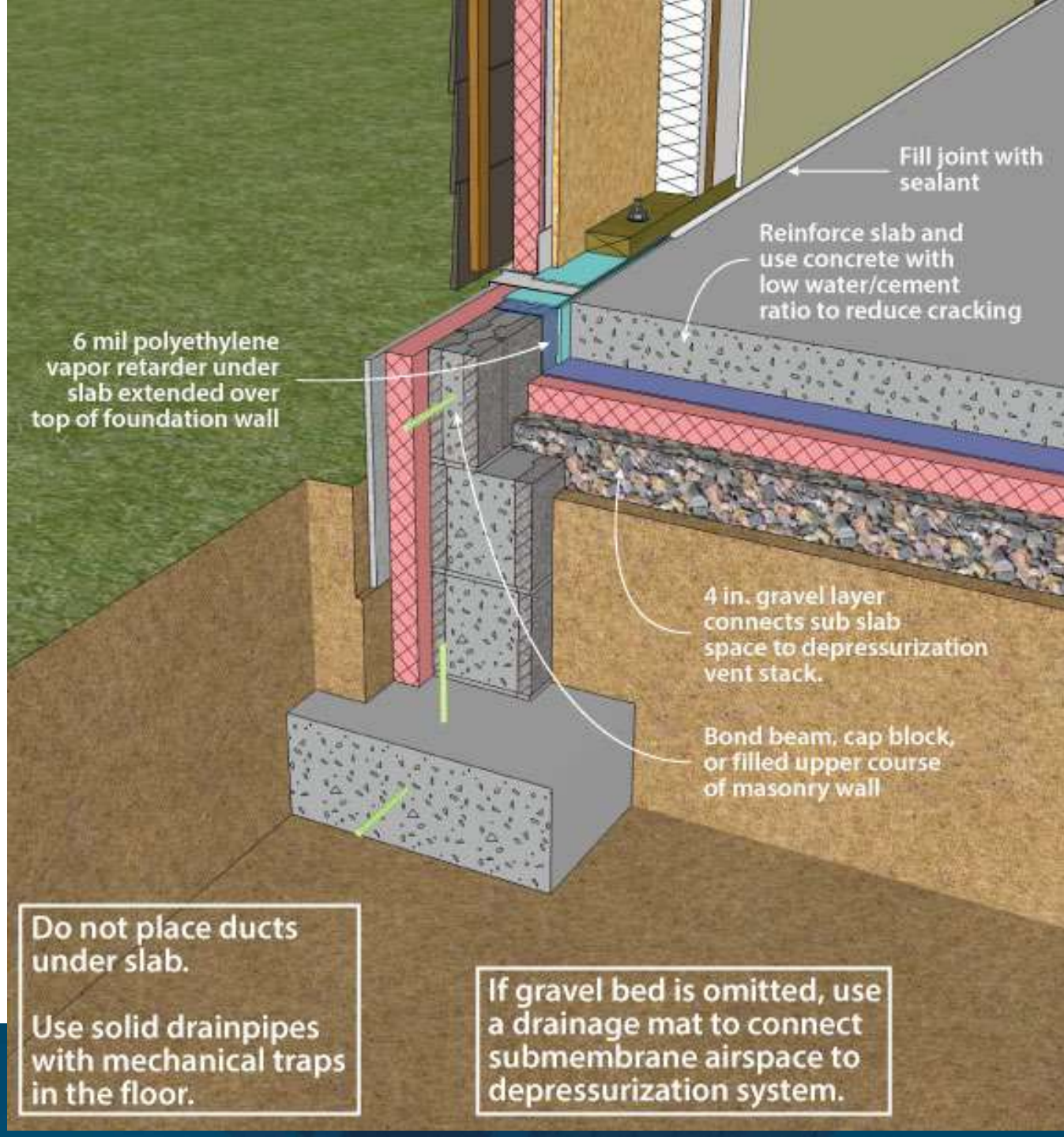
NO free draining gravel at the surface near foundation!

Slab Foundation

- Site drainage away
- Exterior waterproofing
- Capillary break between footing & foundation wall
- **Min. 10ml vapor barrier**
- Capillary Break / course gravel
- **Concrete slab over VB**



Common Building Defects / Solutions

1. Drainage
2. Deflection
3. Drying
4. Details

Follow the WATER

Design With Overhangs

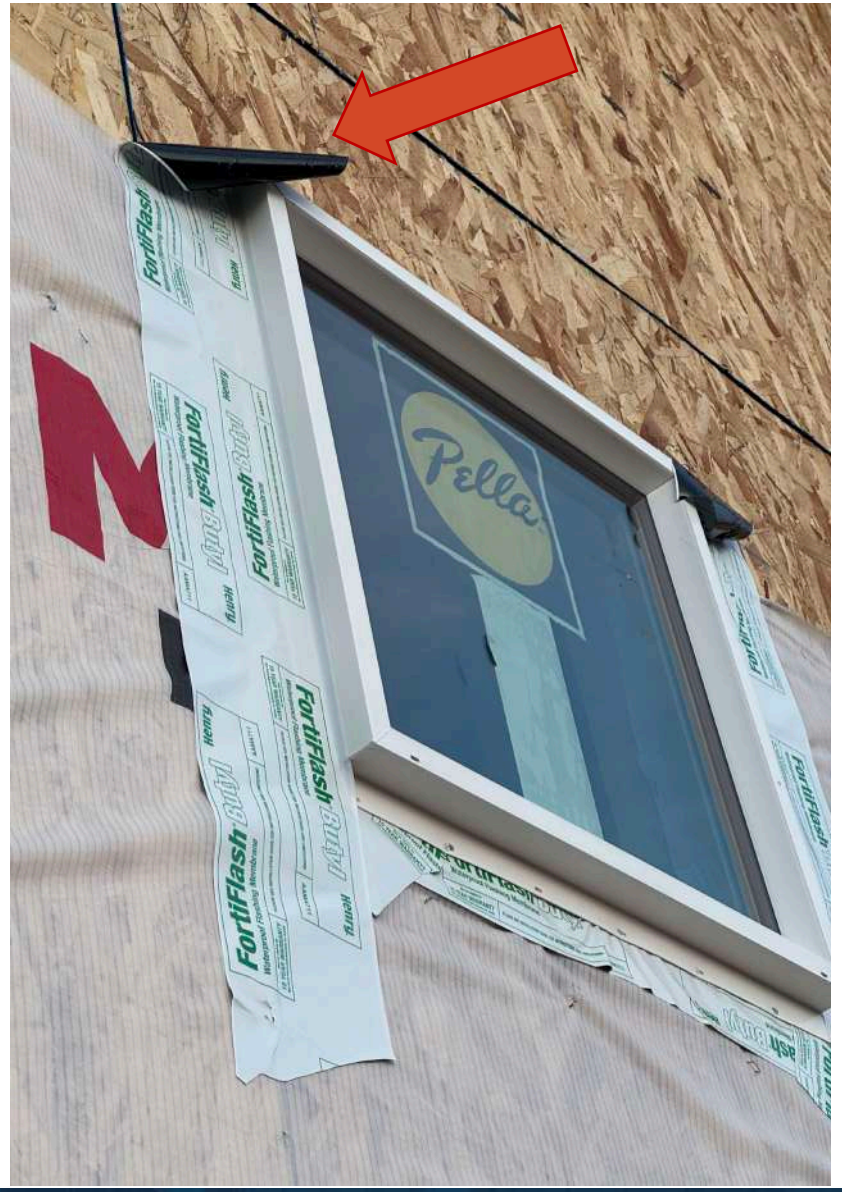
No Overhangs = No Protection

Roof Drainage

Drainage Planes - Reversed Shingled

Wall Drainage Defects

Attention to Proper Shingling



Roof Drainage & Gutters

https://basc.pnnl.gov/resource-guides/step-and-kick-out-flashing-roof-wall-intersections#quicktabs-guides=7
https://www.jlconline.com/training-the-trades/kickout-flashing-required-by-code-yet-often-overlooked_o

https://basc.pnnl.gov/resource-guides/step-and-kick-out-flashing-roof-wall-intersections#edit-group-cad

https://basc.pnnl.gov/resource-guides/step-and-kick-out-flashing-roof-wall-intersections#edit-group-description

Common Building Defects / Solutions

1. Drainage
2. Deflection
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Design the HVAC with Building Design

NO ducts or mechanical equipment in unconditioned spaces!

Avoid HVAC being an after-thought!

Exhaust / Venting Locations - Follow the Air

Avoid exhaust outlets in soffits!

What is Attic Black Mold and W...
checkthishouse.com

Ventilation Won't Prevent Attic Mo...
healthyindoors.com

Attic Black Mold | How to Preve...
checkthishouse.com

Black Mold Attic Plywood: Top ...
bestatticroom.com

Mold in Attics - Why
certifiedinspections.c

What it is and ...

Attic Mold 101 - ATMOX
atmox.com

Soffit vent chutes | Quigley Attic Mol...
quigleyatticmold.com

What Causes Mold Growt...
murphyinspect.com

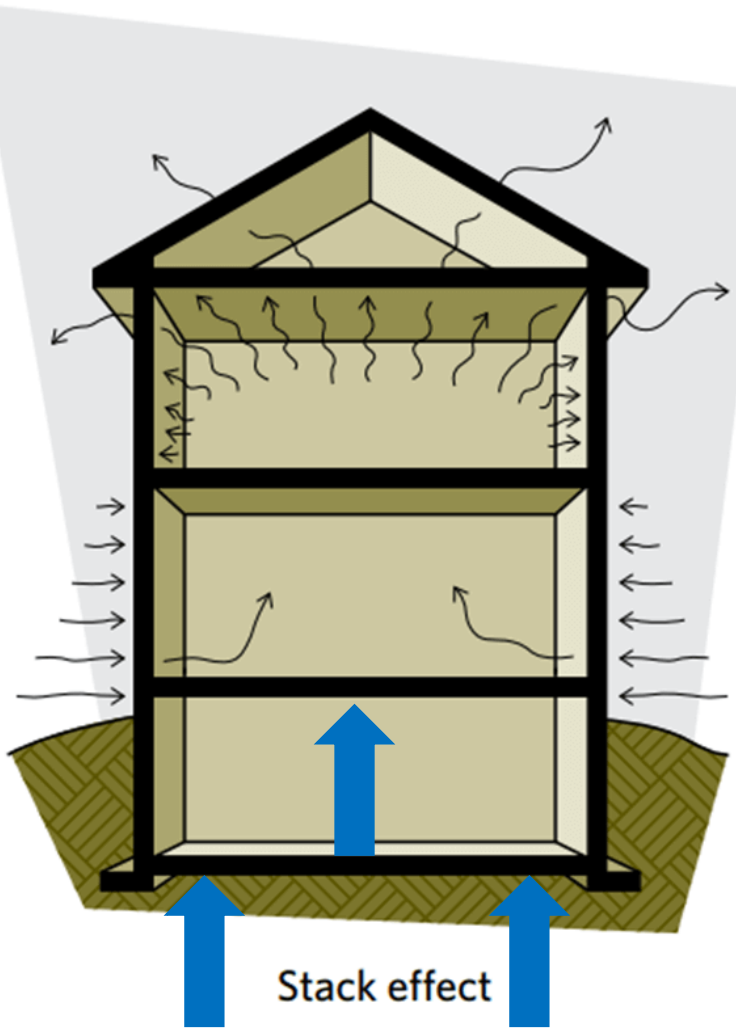
Blocked soffit vents 050 |
quigleyatticmold.com

Just Say NO!

Condition Crawlspaces & Basements

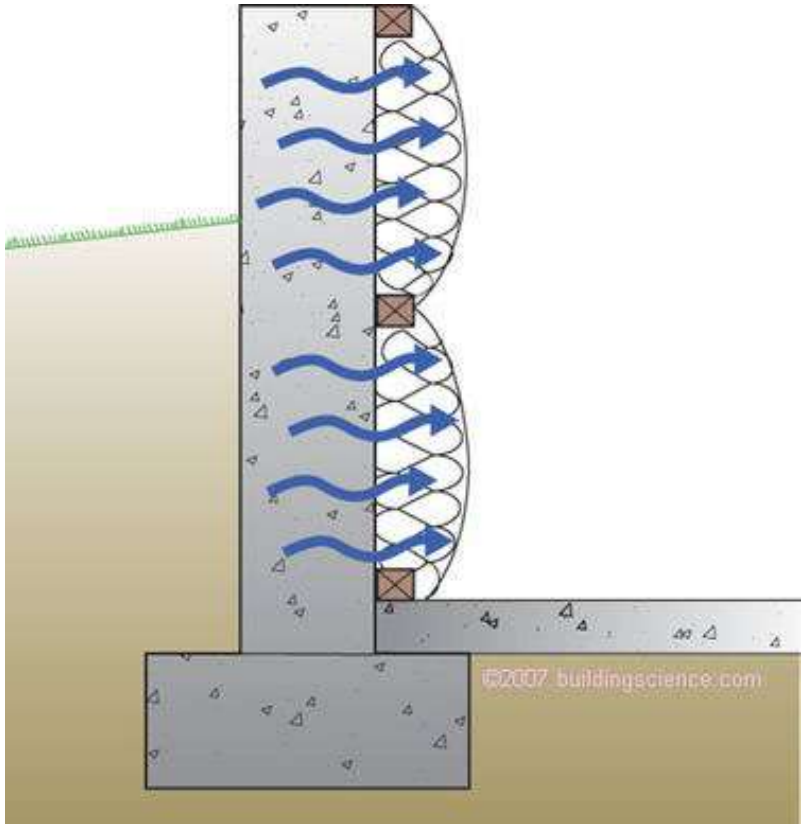
Provide dedicated dehumidification!

Flooring as Vapor Barrier Mold - Slabs & Above Crawl Spaces



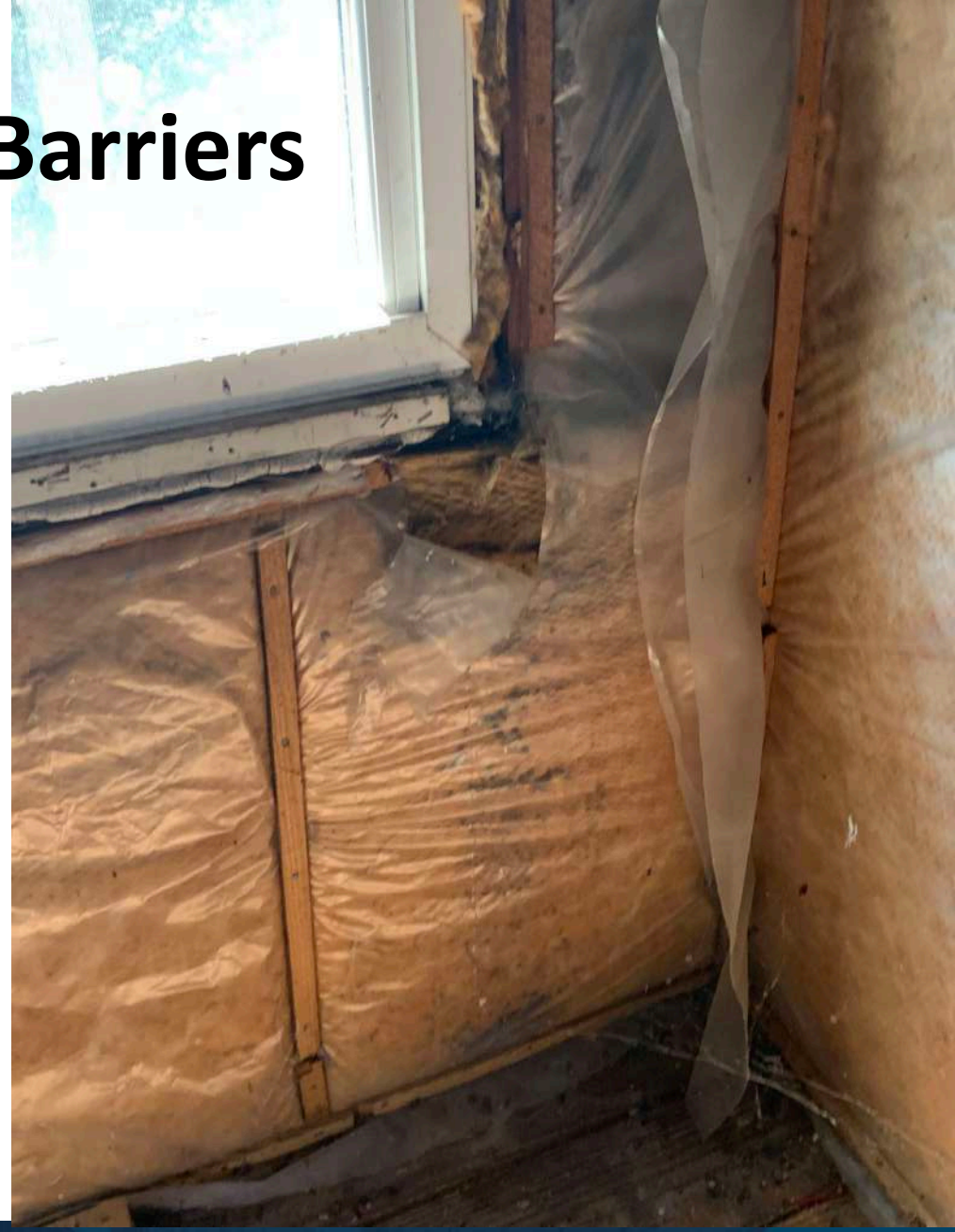
Vapor Barriers/Retarders & Below Grade Walls

- No interior vapor barrier
- Only vapor OPEN insulation



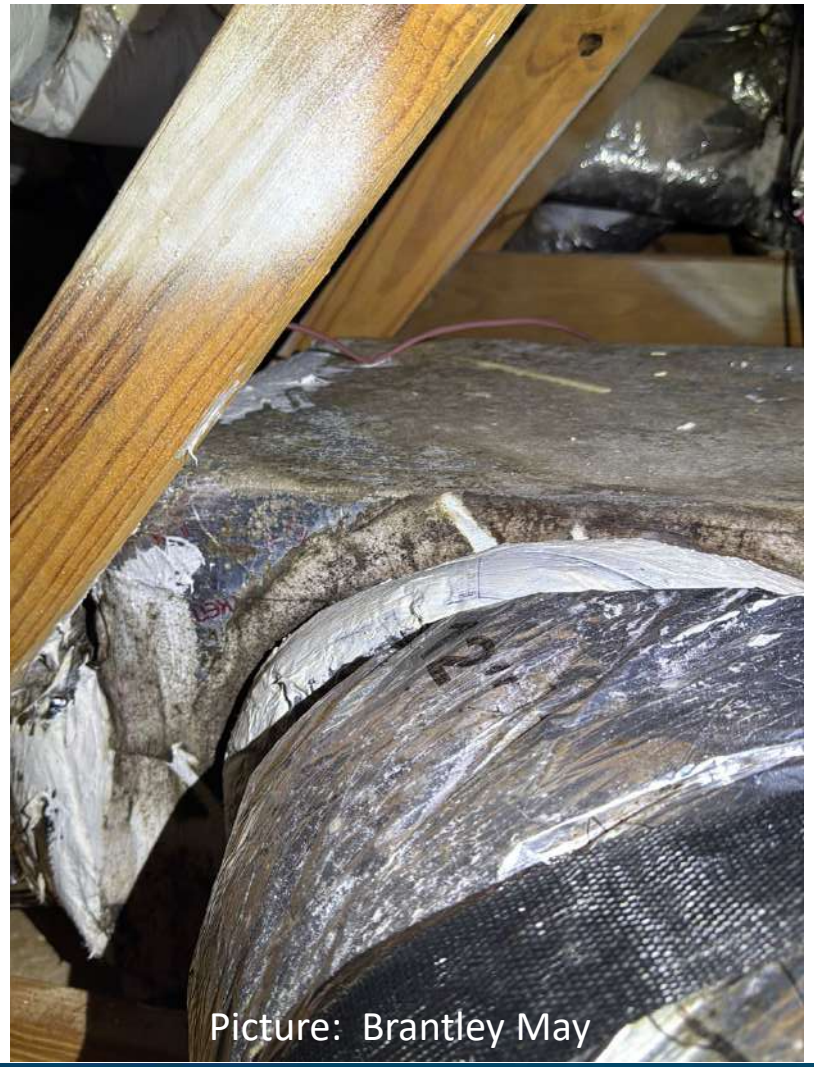
https://buildingscience.com/documents/digests/bsd-103-understanding-basements

Moisture Trapped Behind Vapor Barriers



Spray Foam - Vapor Barrer

Air Gaps in Spray Foam - Mold on Surfaces FL


Picture: Brantley May


Picture: Brantley May


Picture: Brantley May

Common Building Defects / Solutions

1. Drainage
2. Deflection
3. Drying
4. **Details**

Health impacts growing…
Attorney specialists in Spray Foam Defects growing also!

Details Overlooked

Seal Wall Penetrations

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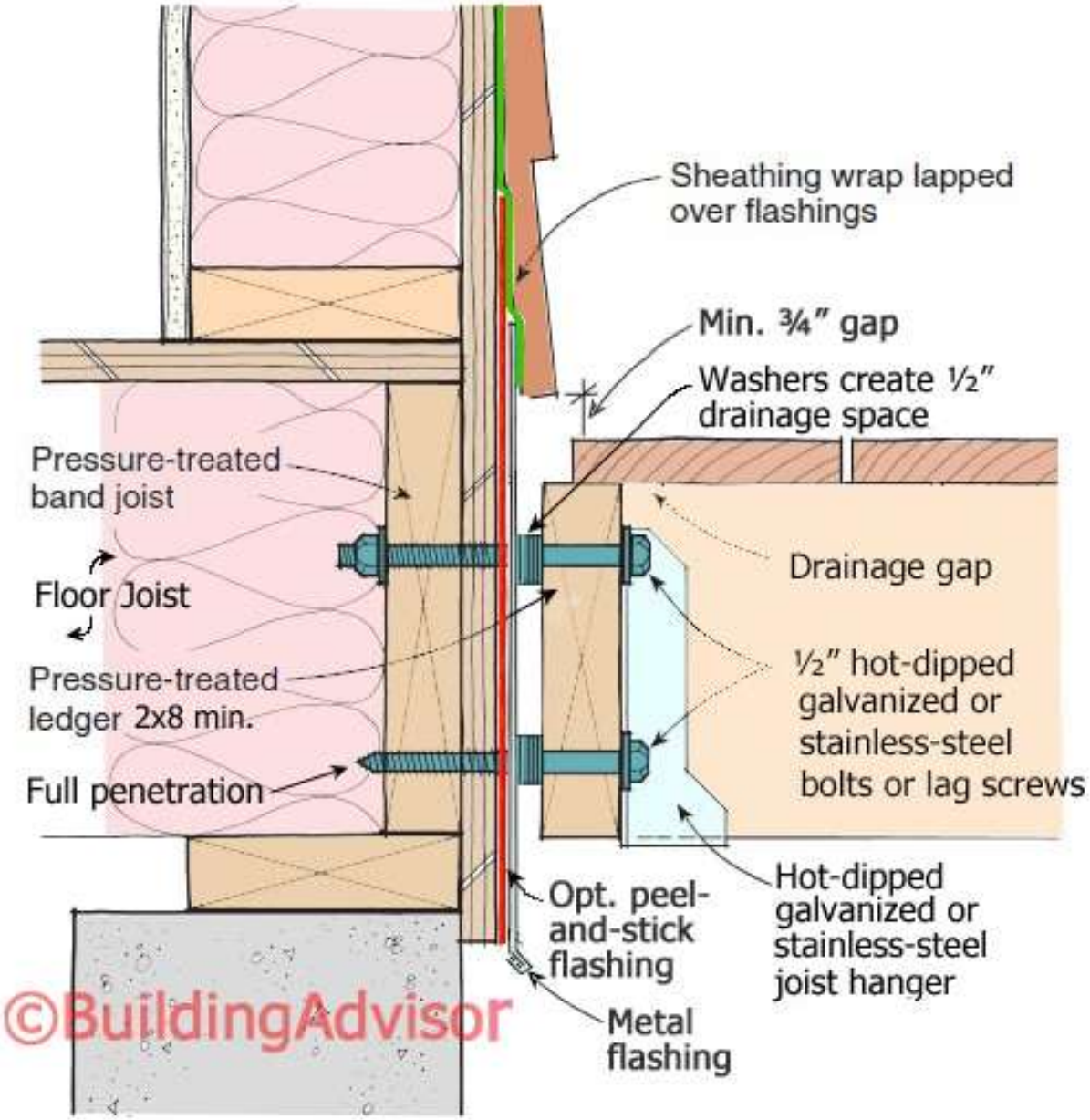
https://buildingadvisor.com/wp-content/uploads/2015/06/Spaced-Deck-Ledger-Detail.jpg

Spaced Deck-Ledger Detail



Summary

Always Consider the Root Cause…

Symptoms

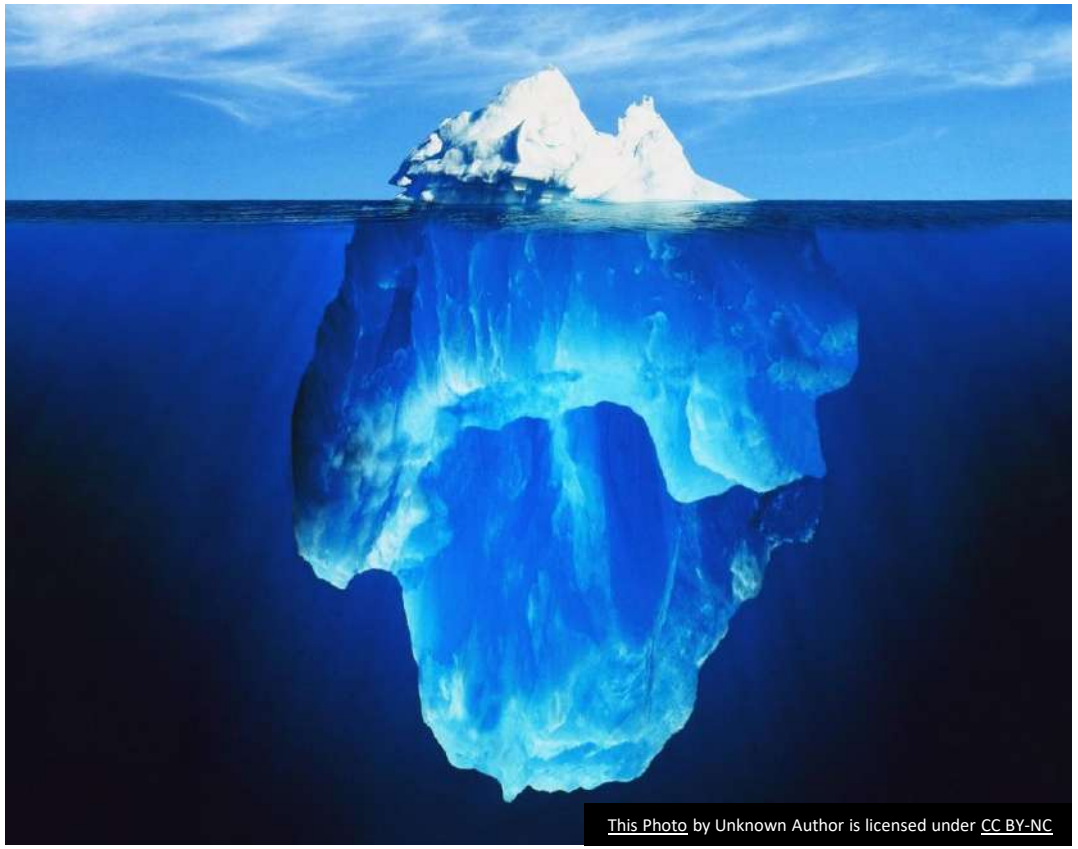
- High humidity
- Poor indoor air quality
- Sick building occupants

The solution is rarely:

Whole house dehumid rs

Whole house air purif rs

ERVs or HRVs



Conditions for Mold Growth?

1. Mold/Fungus Spores
2. Oxygen
3. Temperature of 30-130 F
   (most common 40-105 F)
4. Nutrient Source

5. Moisture

Mold Food… Moisture = Humidity

Design for Moisture Management is the beginning…

Reinforce through:

- Proper construction
- Quality assurance
- Commissioning of the building enclosure.

- **Also… ongoing inspection and maintenance**
  - **Ensure performance is sustained**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Cheryl Ciecko
The Art of Building Wellness

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