Everything a Health Physicist needs to know about Radon Mitigation

Presented by
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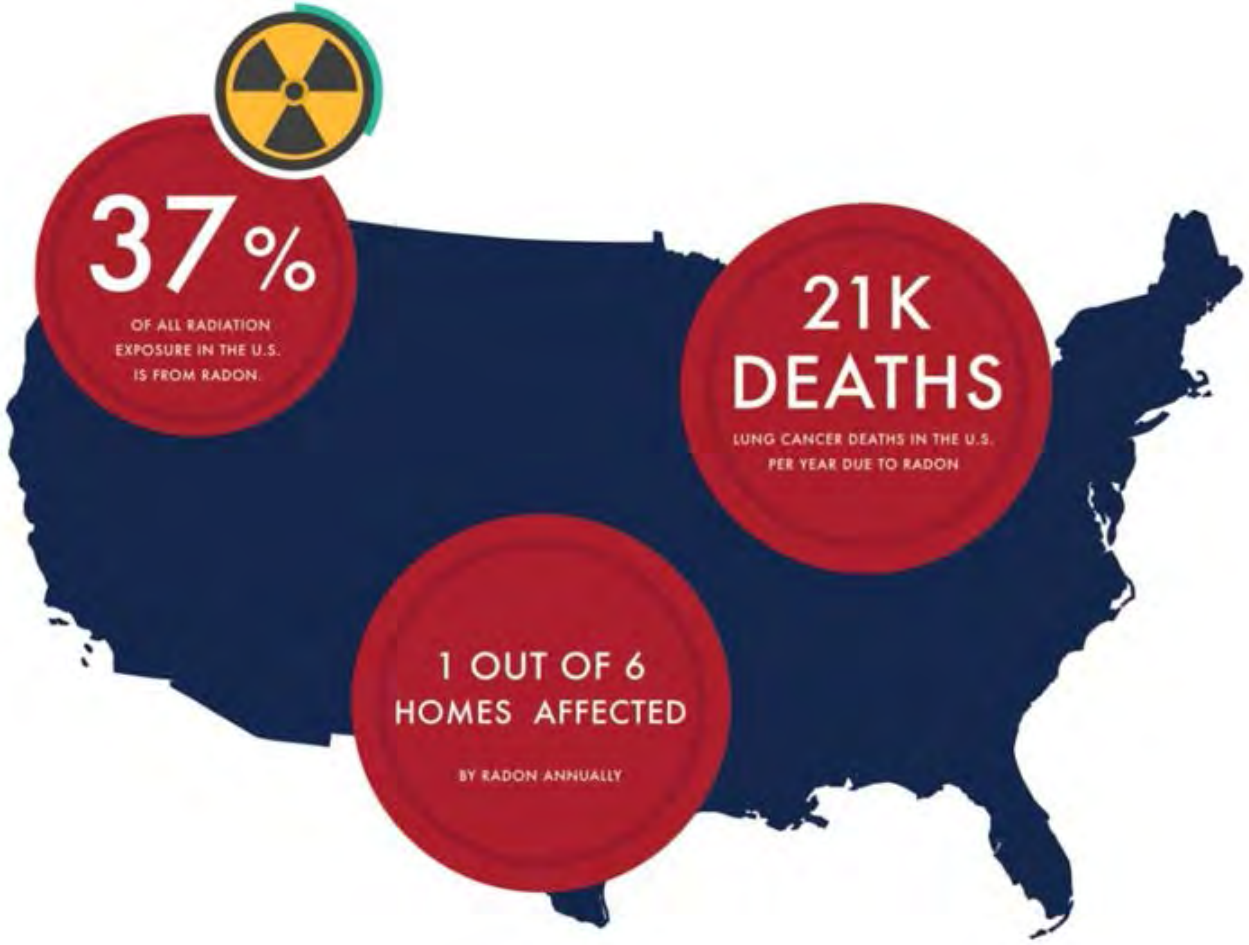
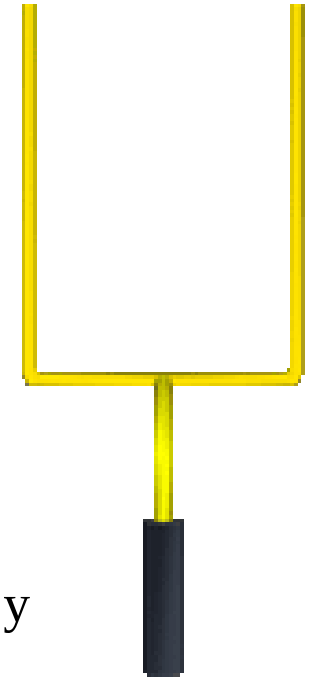
Radon in Homes



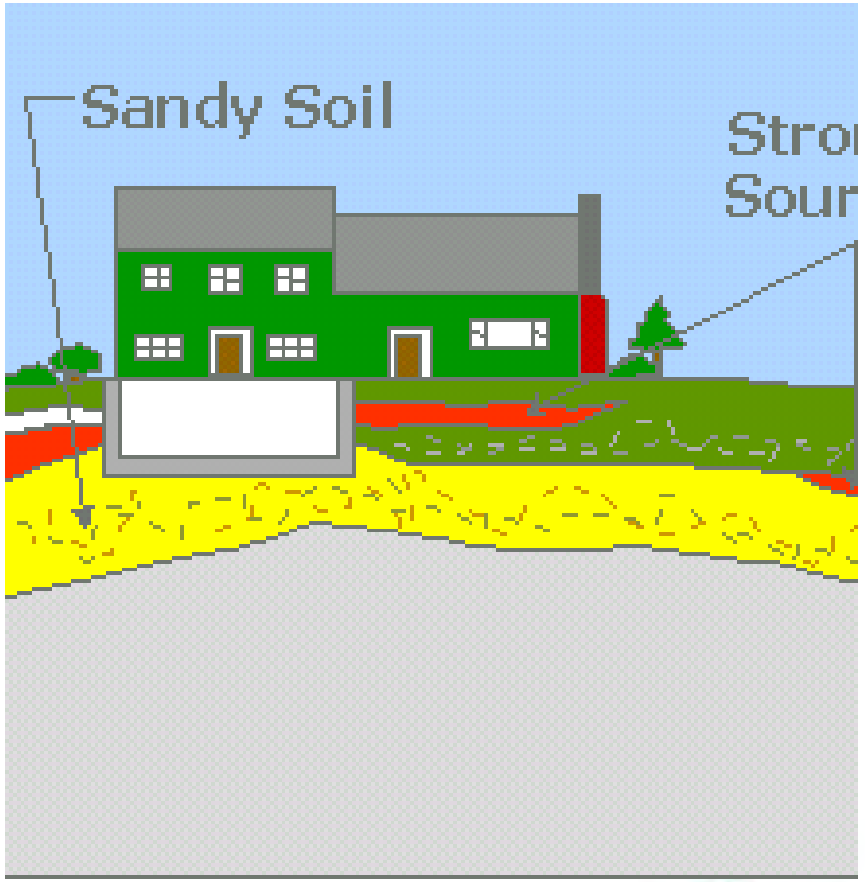
Reduction Goal

- Better indoor air
- Below U.S.EPA Action Level—4.0 pCi/L
- U.S. EPA Recommendation—Consider fixing between 2 and 4 pCi/L
- World Health Organization 2009 Recommendation—2.7 pCi/L (100 Bq/m^3)
- Many can be reduced below 1 pCi/L
- Most effective system with least energy penalty at reasonable cost



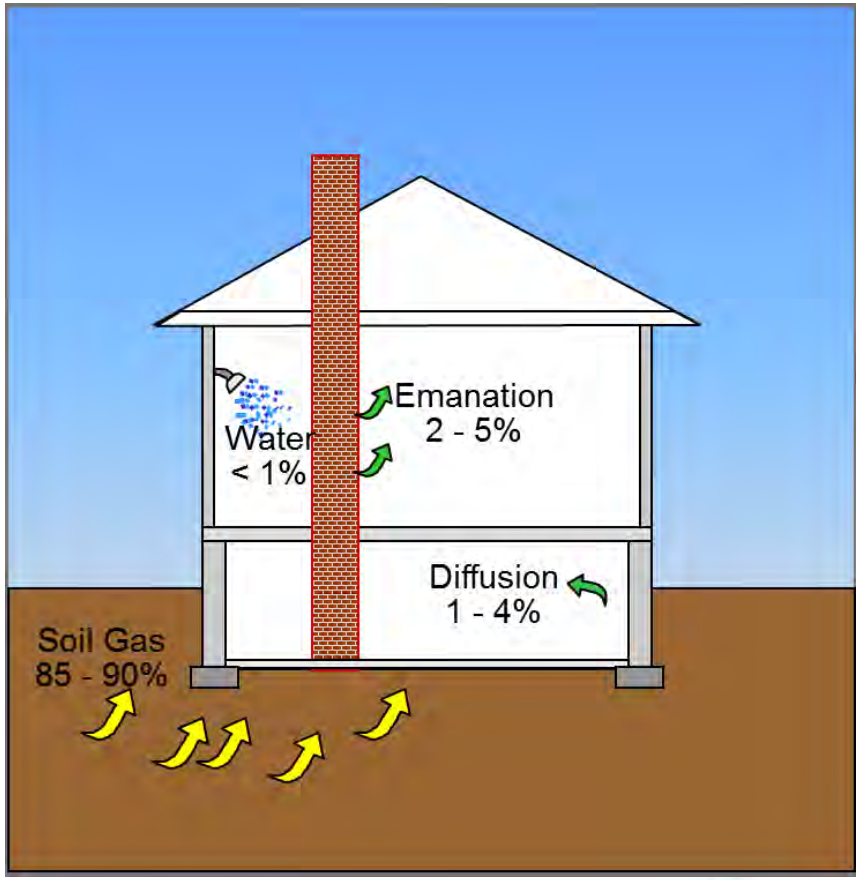
Every home is different

- Radon concentration in buildings affected by
  - Radon source strength
  - Pathways in the soil
  - Transport mechanisms
  - Building ventilation rate
  - Openings to the radon source



Average percentages from sources

- Soil gas major factor
- Percentages for soil gas, emanation, water, and diffusion vary from home to home



Radon Entry

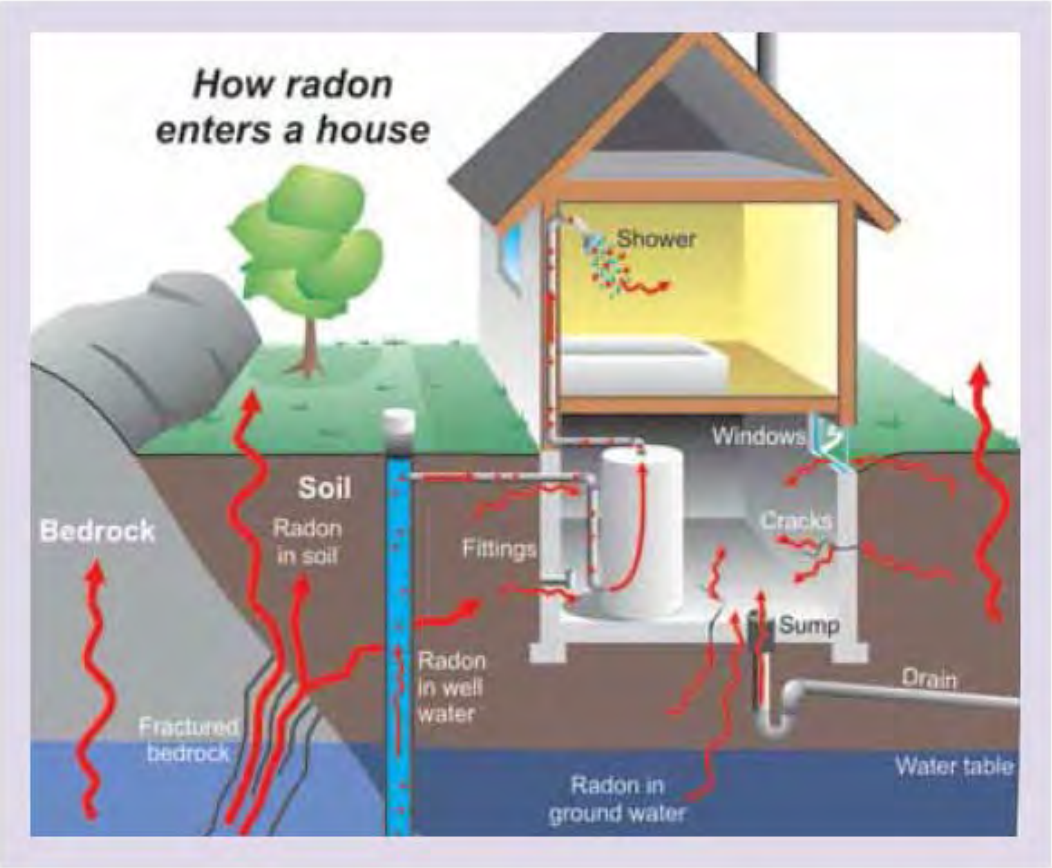


Figure 1 – Radon Movement (Illustration Courtesy of Natural Resources Canada)

Reduction Approaches

- Inhibit radon from entering
  - Control source
  - Control transport mechanism
  - Control pathways
- Reduce radon/progeny after entry
  - Ventilation
  - Filtration
    - Other Source Controls: Water + Emanation

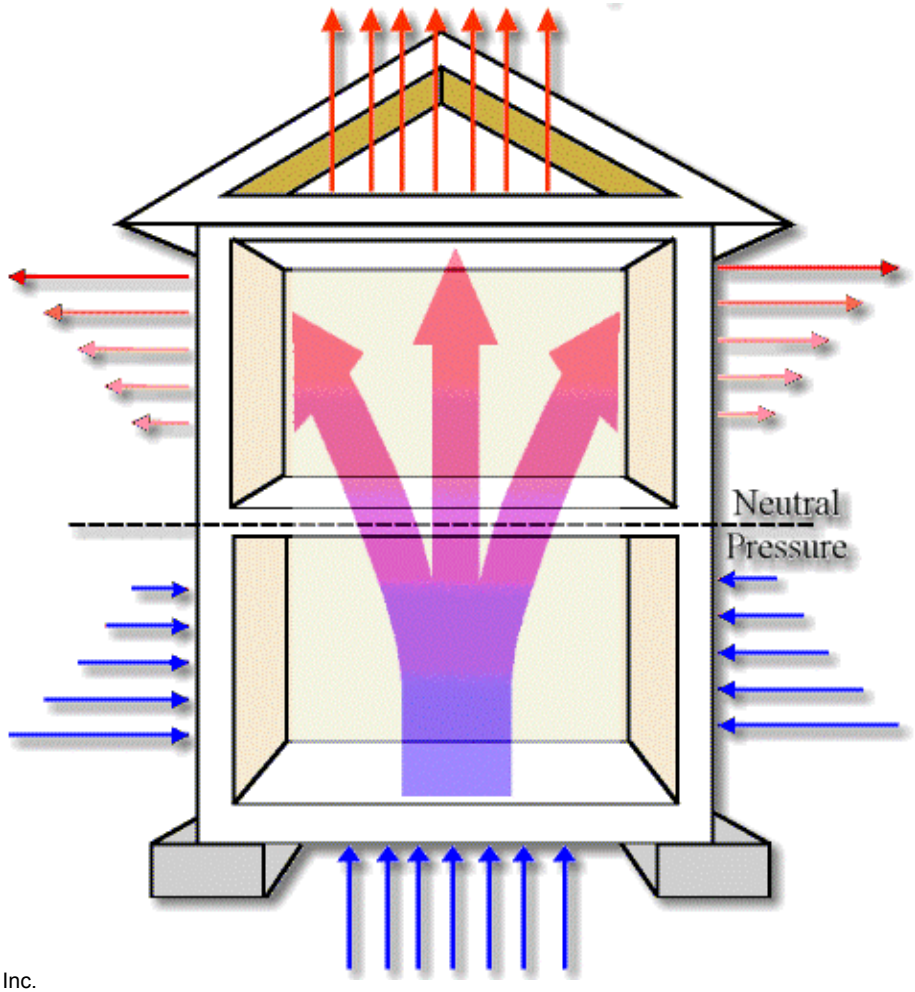
Source – Soil

- Rarely excavation/removal
- Generally use Control of transport mechanisms

Controlling Transport Mechanisms: Depressurization

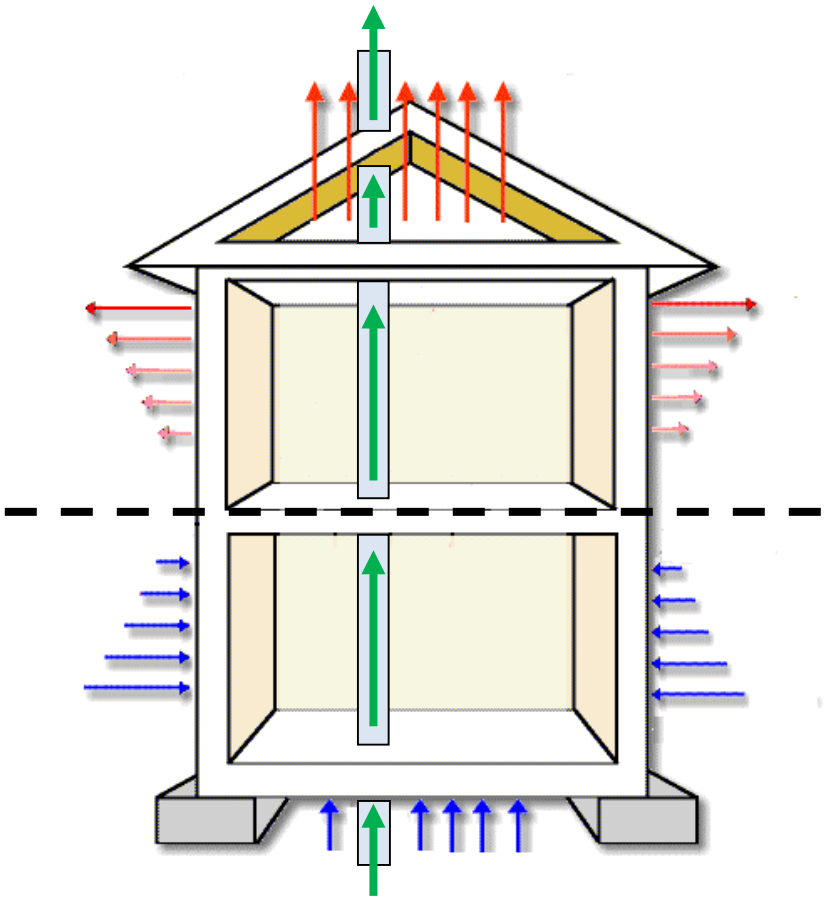
- Active Soil Depressurization (ASD)
  - Sub-slab depressurization (SSD, SSV, SSS)
  - Drain tile depressurization (DTD)
  - Sub-membrane depressurization (SMD)
- Block-wall depressurization (BWD) Combination

ASD Theory



Negative Pressure on the Soil

- Override house's negative pressure
- Redirect and exhaust gases



Building Investigation

- Examine existing radon test data
- Site investigation
  - Building structure
  - Pathways
  - Possible suction hole placement
  - Placement cautions
- Diagnostics

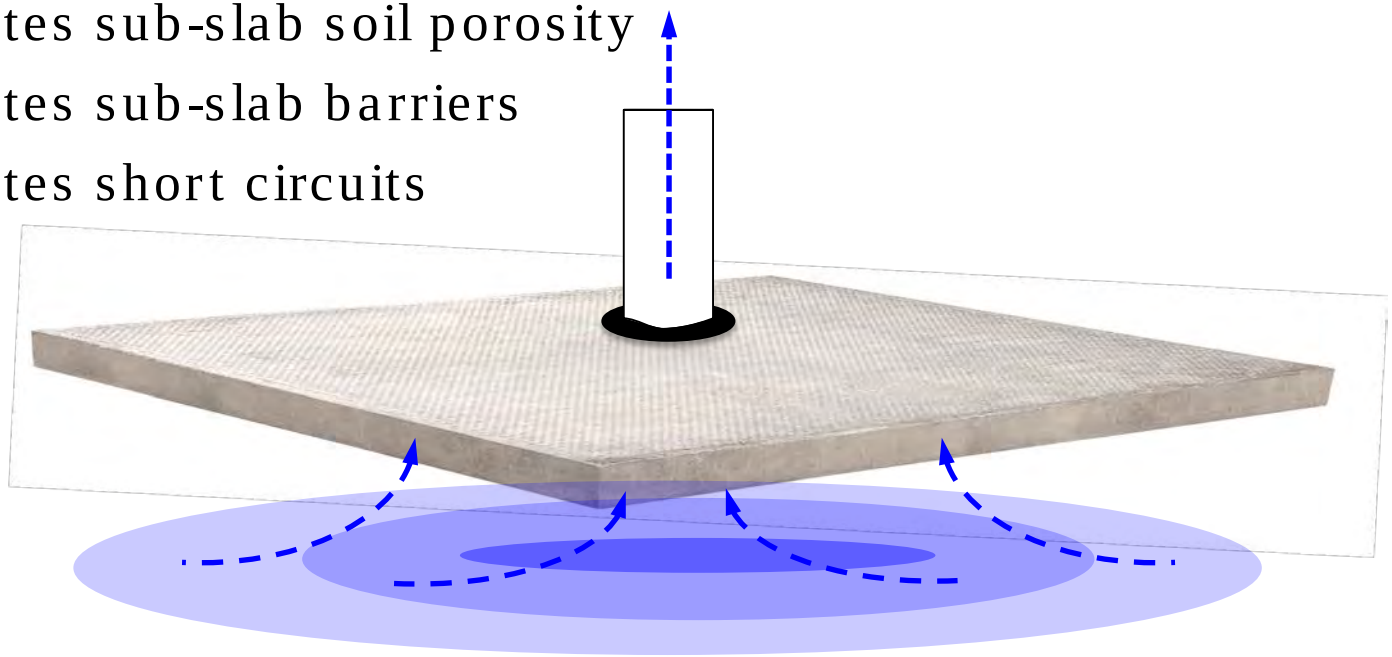
Diagnostic measurements

- Aid design of mitigation system
- Continuous monitors — determine unusual entry patterns
- Sniffing measurements taken at suspected entry points
- No protocols for interpretation other than those associated with the device itself

Sub-Slab Communication Tests

•Establishes pressure field extension—If my suction hole is here, will I pull from enough area sub-slab?

- Indicates sub-slab soil porosity
- Indicates sub-slab barriers
- Indicates short circuits



Pressure field extension

Sniffer

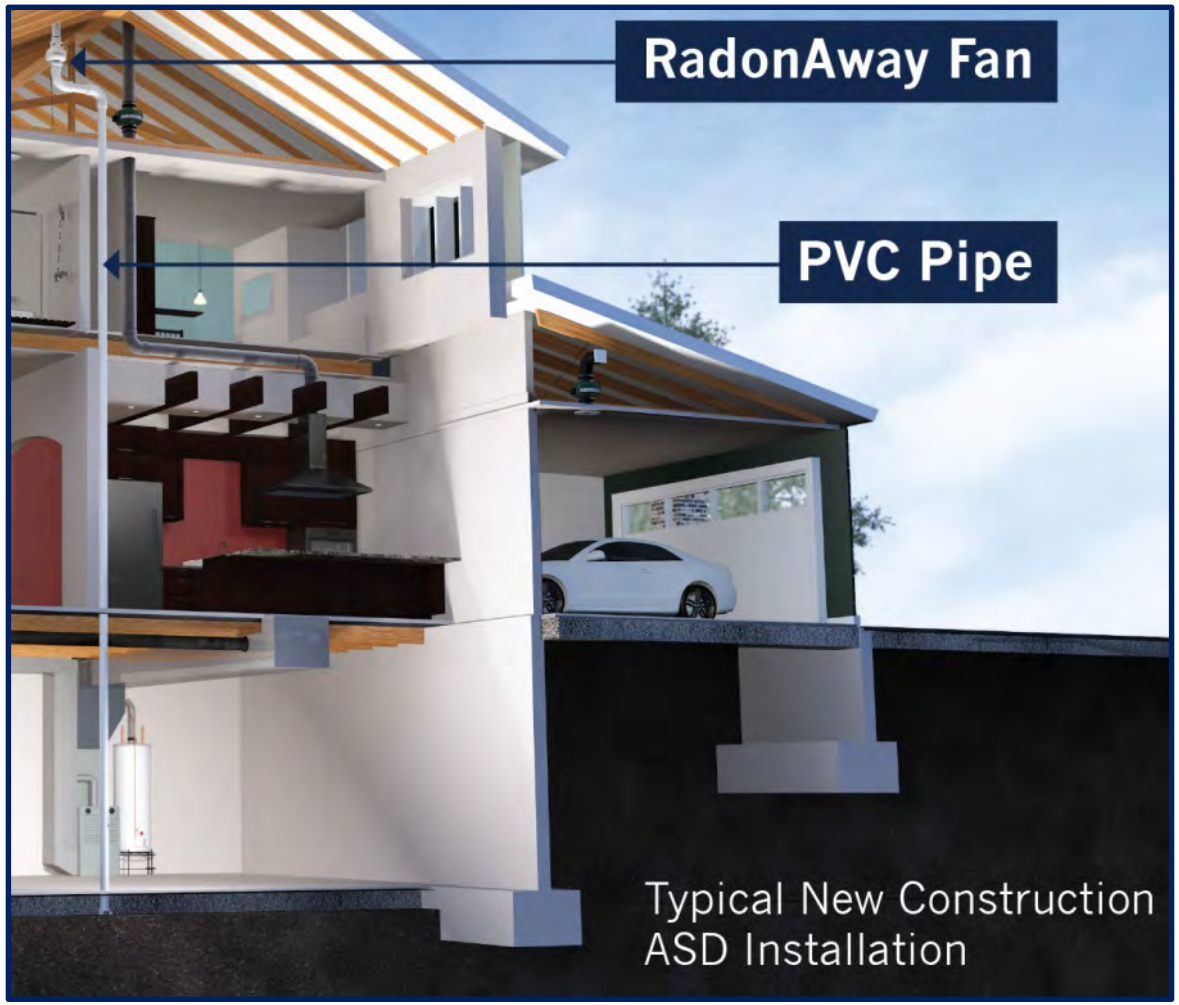
- Quickly identify area/ areas where radon entry strongest
- Identifies required pressure field extension test points (flow must be reversed or lessened at these points)
- Can eliminate radon entry points
  - Aids in system design
  - Might not have to treat certain areas

Overview of ASD

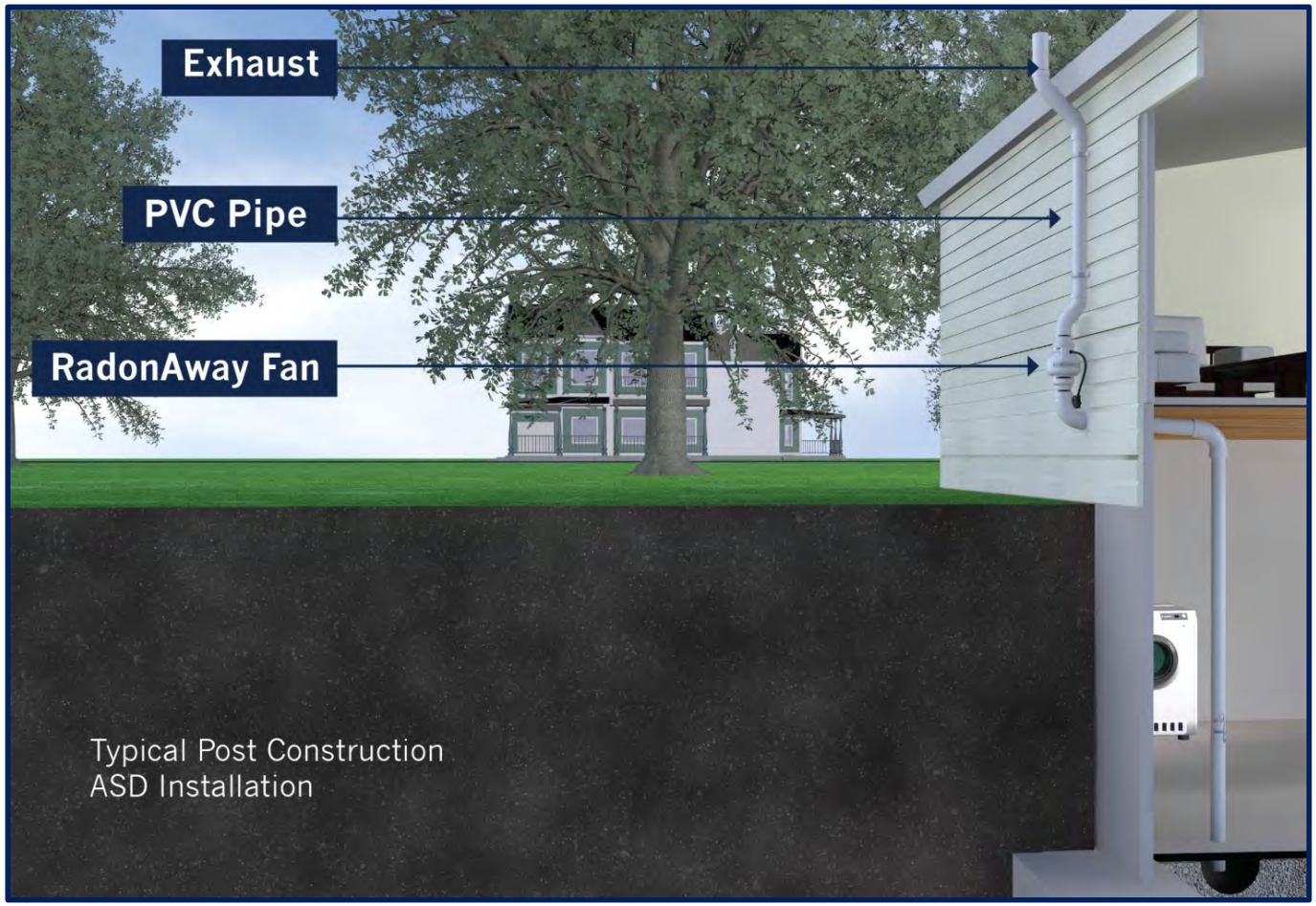
- Active soil depressurization (ASD) describes a group of techniques used to reduce radon, water vapor, soil gas and volatile organic compound (VOC) concentrations in homes and other buildings.

- ASD techniques create a negative pressure field below the building to inhibit radon, moisture and VOC entry and to allow gases and vapor to be drawn from beneath the slab and vented above the roof line.

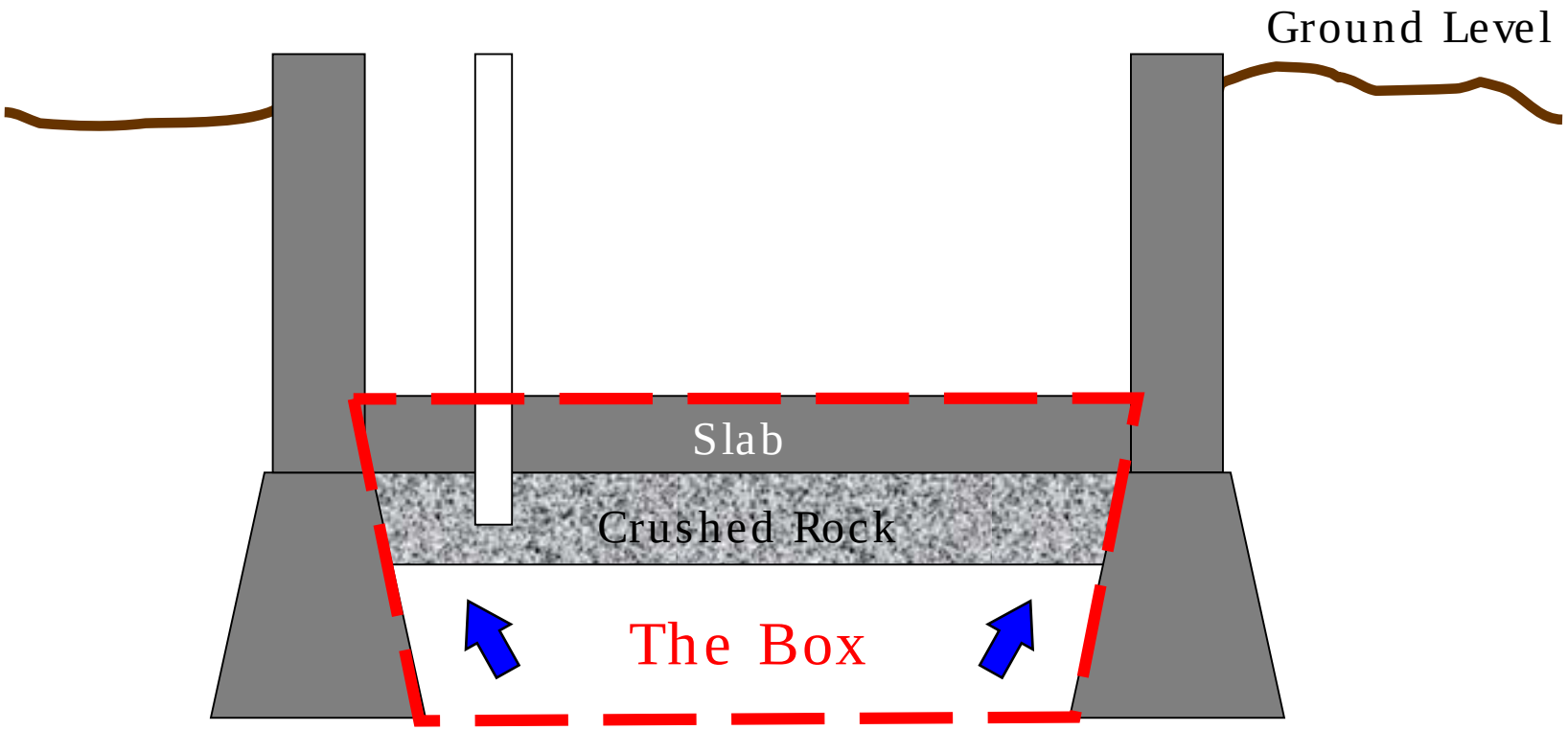
ASD Components - Interior



ASD Components - Exterior



ASD Sub-Slab

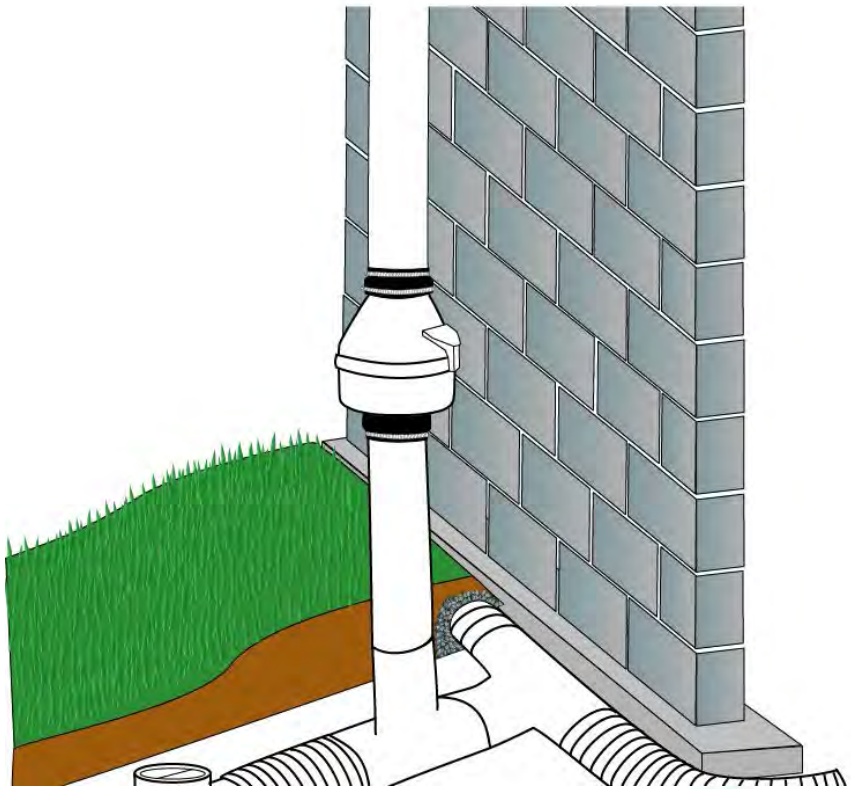


Sub-slab Barriers to Pressure Field Extension

- Clay (1)
- Sand (2)
- Compacted soil (3)
- Concrete (4)
  - Spills
  - Interior footings

Drain-tile depressurization

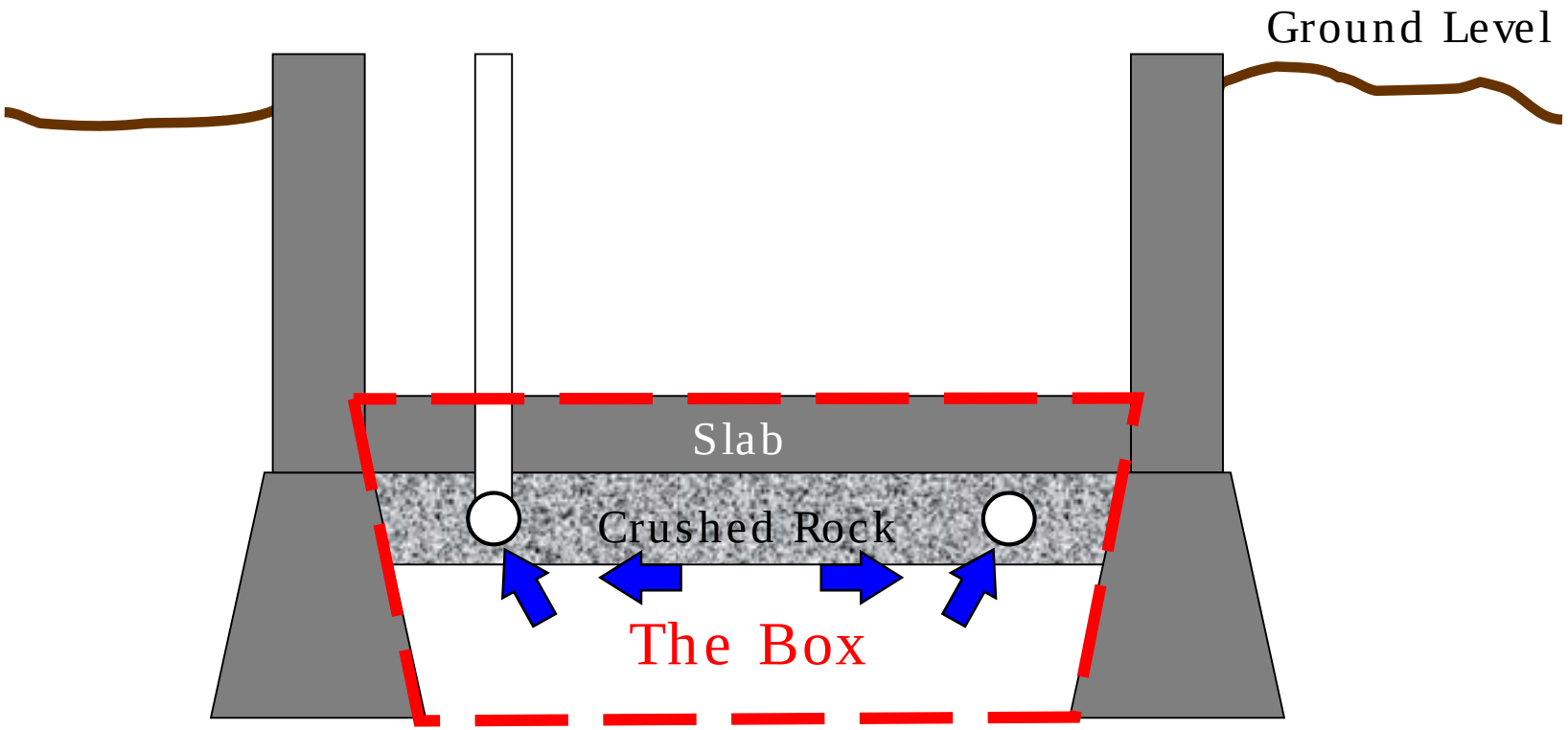
- Exterior trench drainage systems can be used to collect and redirect radon
- Ends of drain pipe should be capped to prevent backflow
- Pipes can be entirely outside the house and effectively camouflaged



Sump depressurization

- Variation of sub-slab and drain tile suction
- Sump capped so it can continue to drain water and serve as location for radon suction pipe
- Sump sealed and system attached to cover, or to drain tiles remote from the sump
- Submersible pump may be required
- Cautions whenever employed

ASD – Drain Tile Depressurization



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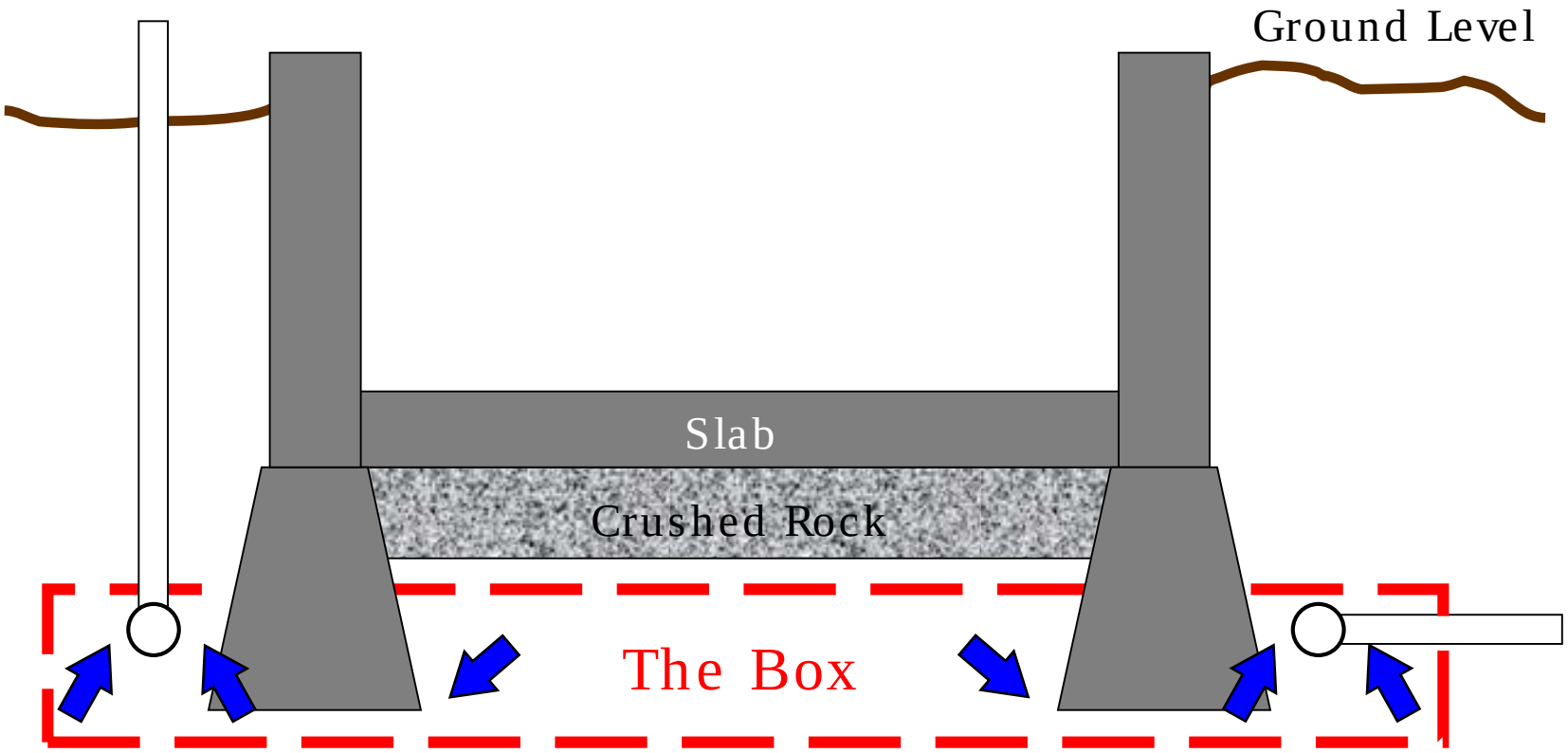
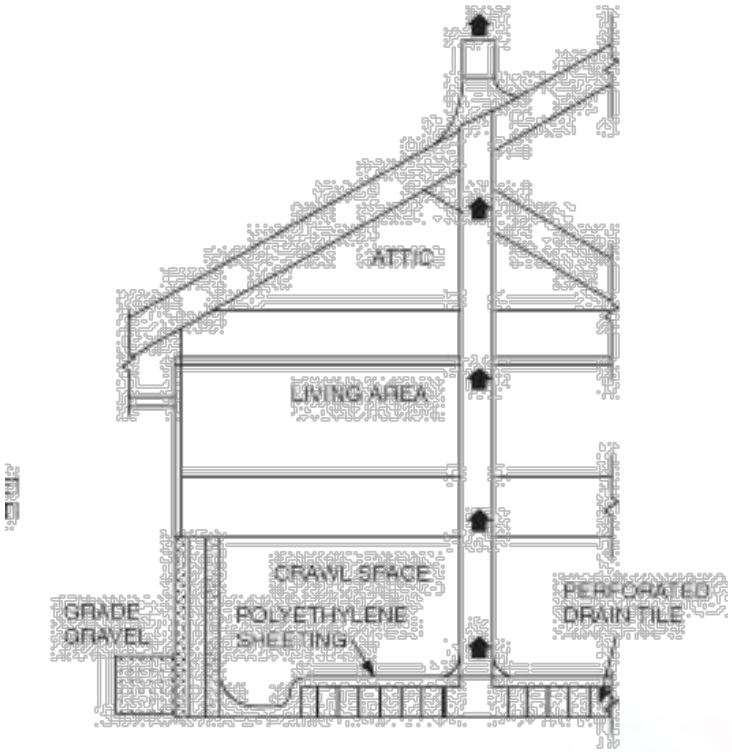
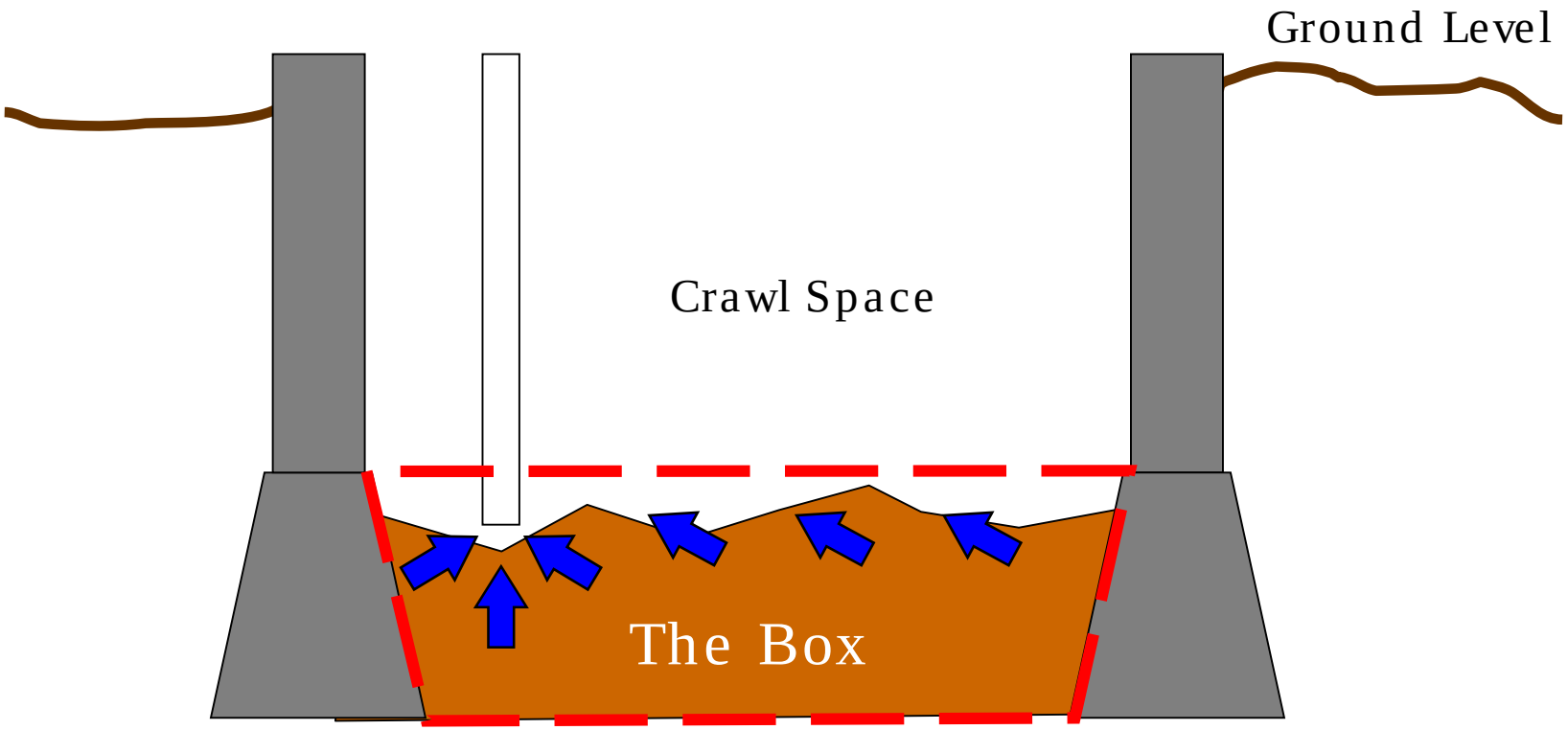


Sub Membrane

- Lay high density polyethylene plastic over pipe & ground
- Attach to walls and seal
- Route outside the building
- Use fan to continuously draw air from behind the membrane

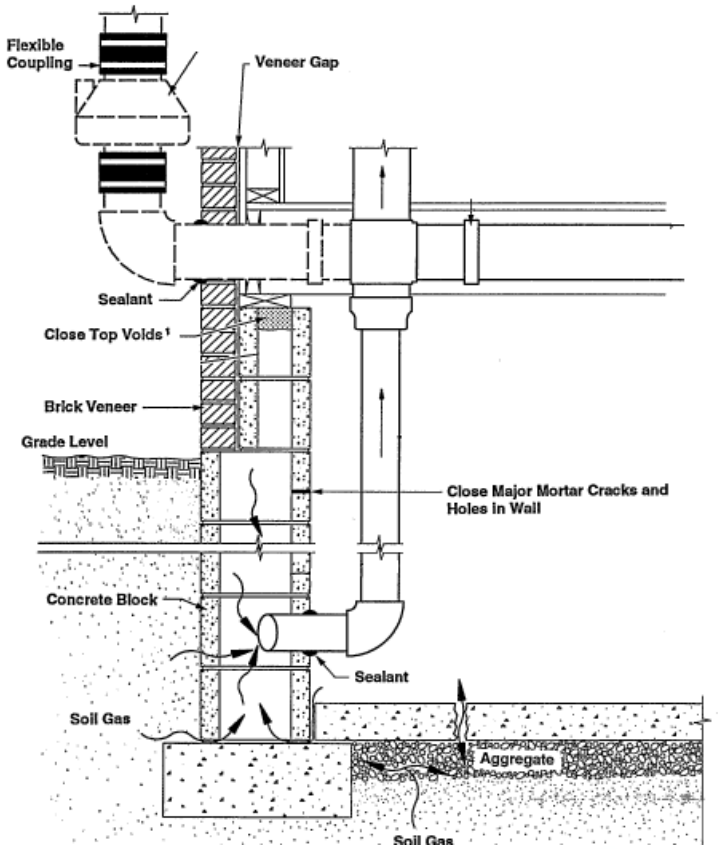


ASD—Sub-membrane Depressurization



Block wall depressurization

- Used in basement houses with hollow block foundation walls
- Removes radon from the hollow spaces within basement's concrete block wall
- Active depressurization creates vacuum on the hollow portion
- Wall tops sealed
- Often used together with subslab suction.

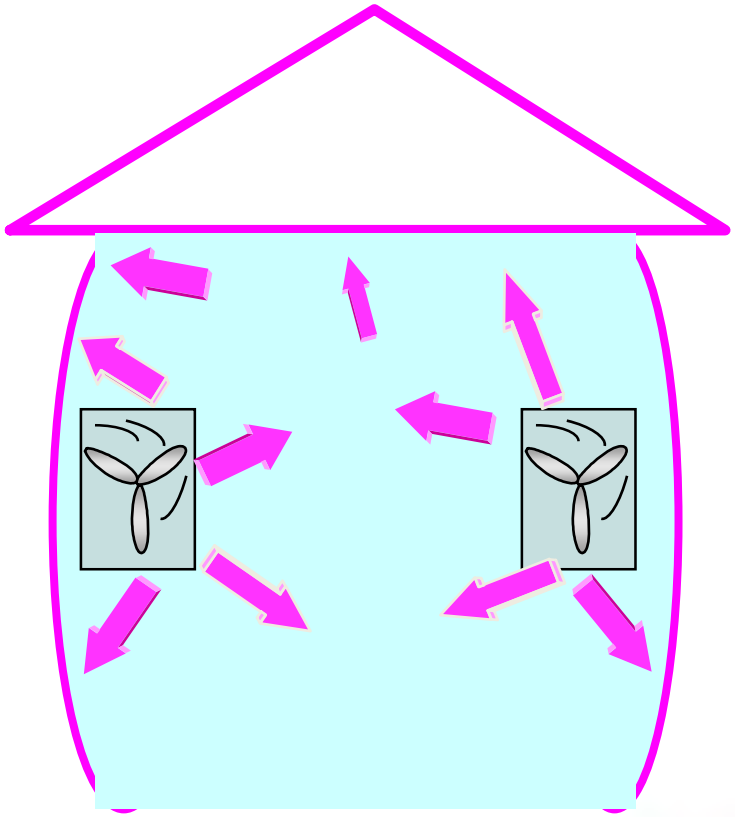


Controlling Pathways

- Sealing
  - Cracks
  - Holes
  - Crawl (etc.) accesses
- Poor stand alone technique
- Mainly used to enhance ASD systems by isolating slab

Pressurization

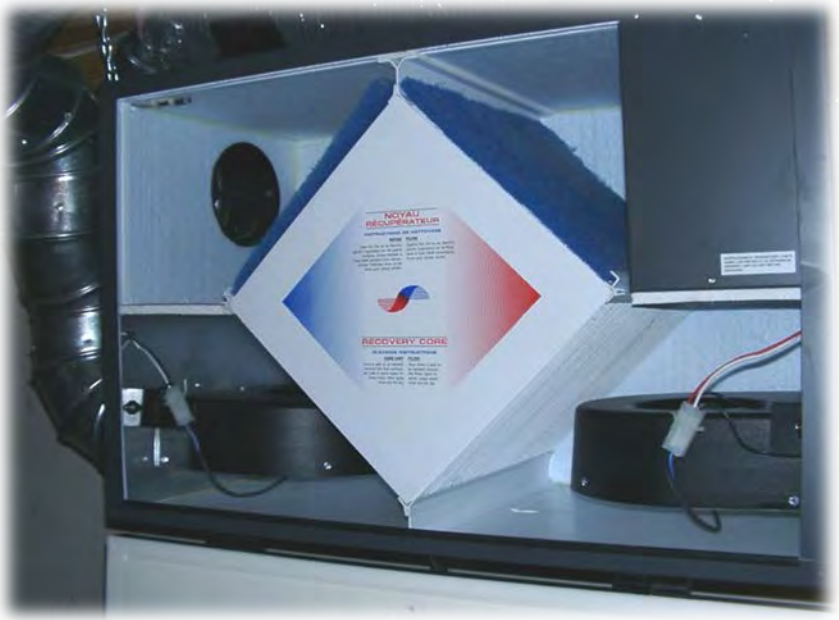
- Mechanical fans bring in outside air
- Pressure increases and can slow radon entry
- Requires building with very tight “skin”
- Most homes not this tight



Control After Entry

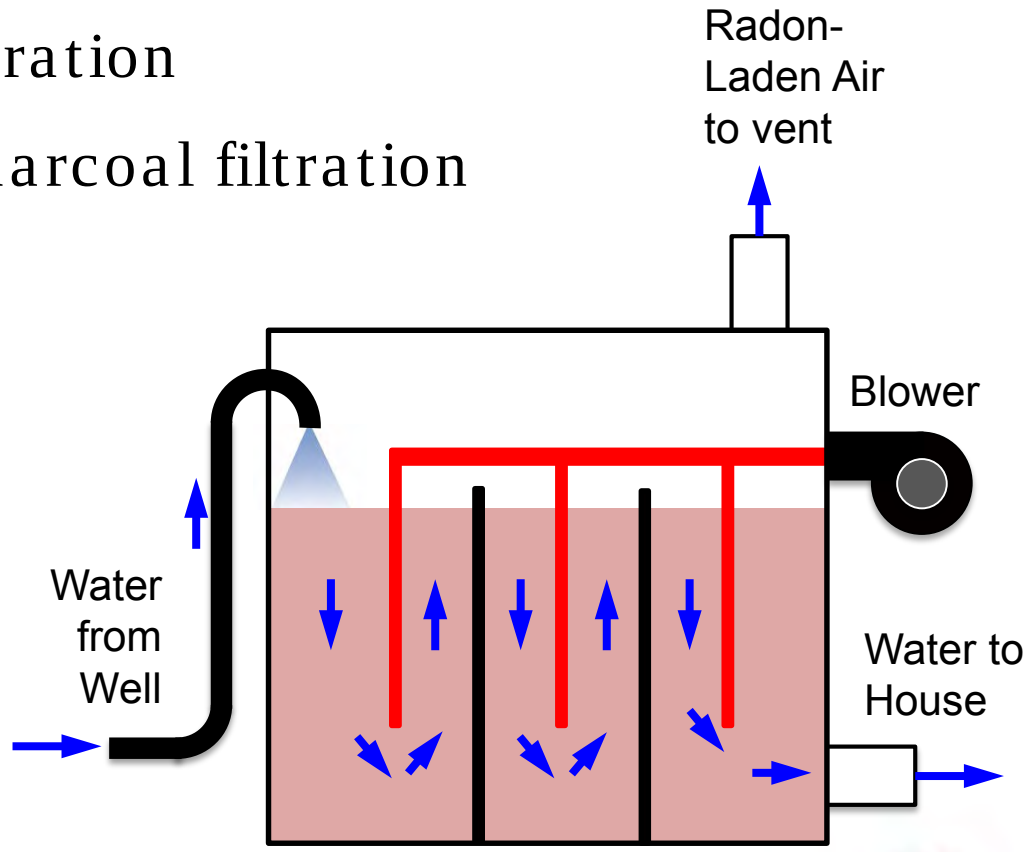
- Dilution/ ventilation
  - Natural
  - Mechanical
    - Heat transfer devices

      HRV
      ERV
      AAHX
- Filtration
  - Questionable effectiveness



Source – Water

- Aeration
- Charcoal filtration



Source – Building Materials

Problem	Solution
Radioactive infill	Removal
Granites	Ventilation
Sheetrock	
Concrete with radioactive aggregate	

Radon Requirements & Standards

- State standards
- EPA Radon Mitigation Standard (RMS)
- ASTM E2121-12 Standard Practice for Installing Radon Mitigation Systems in Existing Low-Rise Residential Buildings
- AARST-ANSI RRNC 2.0 Standard
  Prescriptive building code with performance requirements.
- AARST-ANSI Residential Home Mitigation
- AARST-ANSI RRNC For Larger Buildings
- AARST-ANSI Mitigating Schools and Large Buildings
- AARST-ANSI Multifamily Mitigation Standard

  Requires qualified mitigation professional