



Radon Resistant New Construction Techniques

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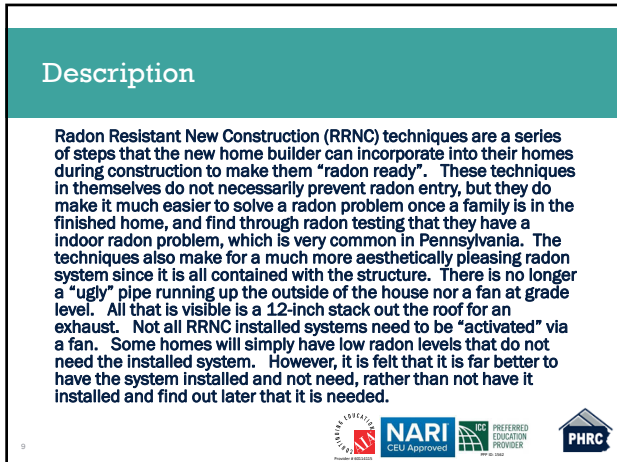
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PennState College of Engineering

PENNSYLVANIA HOUSING RESEARCH CENTER

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Description

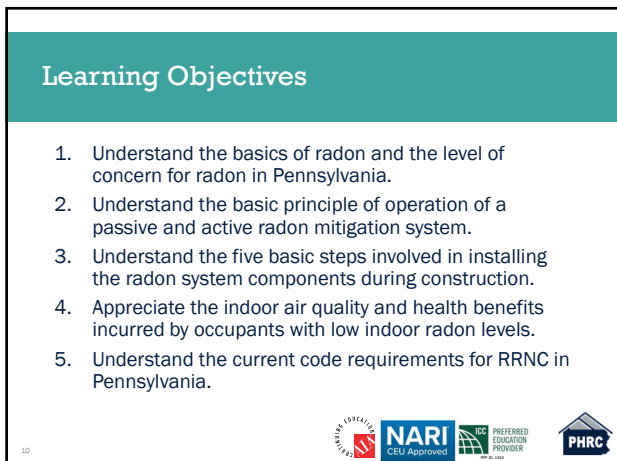
Radon Resistant New Construction (RRNC) techniques are a series of steps that the new home builder can incorporate into their homes during construction to make them "radon ready". These techniques in themselves do not necessarily prevent radon entry, but they do make it much easier to solve a radon problem once a family is in the finished home, and find through radon testing that they have an indoor radon problem, which is very common in Pennsylvania. The techniques also make for a much more aesthetically pleasing radon system since it is all contained within the structure. There is no longer a "ugly" pipe running up the outside of the house nor a fan at grade level. All that is visible is a 12-inch stack out the roof for an exhaust. Not all RRNC installed systems need to be "activated" via a fan. Some homes will simply have low radon levels that do not need the installed system. However, it is felt that it is far better to have the system installed and not need, rather than not have it installed and find out later that it is needed.

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Learning Objectives


1. Understand the basics of radon and the level of concern for radon in Pennsylvania.
2. Understand the basic principle of operation of a passive and active radon mitigation system.
3. Understand the five basic steps involved in installing the radon system components during construction.
4. Appreciate the indoor air quality and health benefits incurred by occupants with low indoor radon levels.
5. Understand the current code requirements for RRNC in Pennsylvania.

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Pennsylvania Housing Research Center


Radon Resistant New Construction
RRNC
 Reasons & Techniques
 January 27, 2022, 11 AM

Tom Wolf, Governor Patrick McDonnell, Secretary

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Radon and New Construction


- **Presenters:**
 - Robert Lewis** PA DEP, Radon Division
Radon in PA and UCC Requirements
 - Bill Brodhead** WPB Enterprises Inc.
RRNC techniques and Installation



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Radon Characteristics

- Naturally occurring, radioactive gas.
- Can't see it, smell it, or taste it
- Prolonged exposure can cause lung cancer
- However, you can test for it!



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Approved Radon Test Devices



Single result test devices



Hour by hour devices



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Reasons for RRNC installations

- The ideal time to install RRNC is during new construction.
- Home builder can install themselves or hire radon mitigation contractor.
- Must be certified mitigator after occupancy.
- RRNC avoids unattractive outside piping.
- RRNC slab & crack sealing saves energy



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RRNC avoids outside radon systems



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Radon in Pennsylvania

PA may have the most severe radon problems in the country.

- Basement average of 7.0 pCi/L
- First Floor average of 3.5 pCi/L
- Widespread distribution
- Significant amount of radon levels > 100 pCi/l
- Large population



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Current Situation

Uniform Construction Code (UCC)
does not include any requirement
for radon features in new construction.

IRC has Appendix F, Radon Control Methods.
This **has been adopted** by some townships



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RRNC specific Documents

- International Residential Code (IRC)
 - Appendix F
- ANSI/AARST CCAH 2020 <https://standards.aarst.org/>
 - Reducing Radon in New Construction of 1 & 2 Family Dwellings and Townhouses
- EPA Indoor airPLUS Qualified Home
 - Version 1 (Rev.04) Feb 2018

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Radon and the UCC

Two methods to adopt RRNC:

- Legislation directs L&I to promulgate
- Legislation directs the RAC to review and adopt.




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IRC Appendix F

- Appendix F is available on-line at.
<https://codes.iccsafe.org/content/IRC2018P4/appendix-f-radon-control-methods>
- Appendix F has been adopted in PA by the following townships:
 - Amity, East Earl, East Hempfield, Ephrata,
 - Hanover, Manheim, Martinsburg Borough,
 - Mount Pleasant, Peters, Pequea, Warrington,
 - West Hempfield, City of Easton.

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Next Speaker is

Bill Brodhead

WPB Enterprises, Inc.

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Become an Indoor airPLUS homebuilder




Program includes:
**House Ventilation
& Radon Control**

Radon Control	Heating, Ventilation and Air-Conditioning (HVAC)	
Pest Management	Moisture Control	Combustion Venting
Pest Management	Building Materials	

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Indoor airPLUS - adding Ventilation

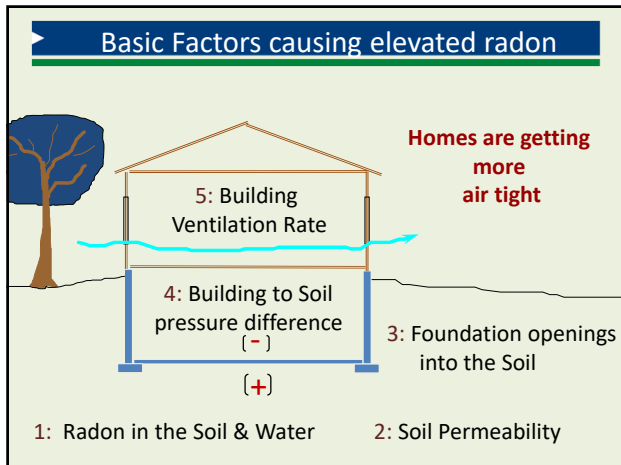


**Homeowners no longer
open windows**

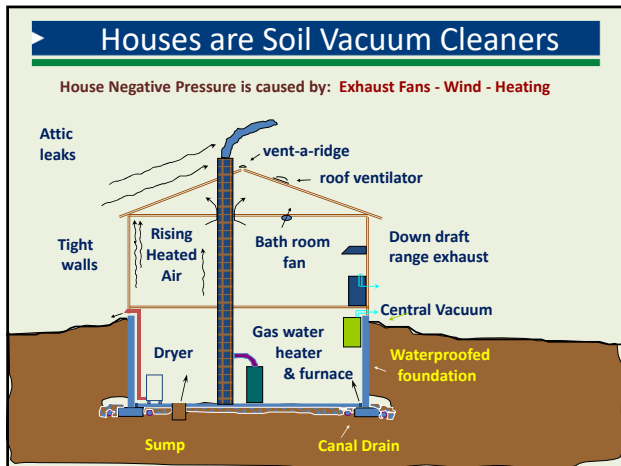
Three Ventilation choices

- 1) Leave a bathroom fan running \$
Causes negative pressure
May increase radon levels
- 2) Run duct from outdoors
into return of HVAC \$\$
Include minimum MERV 8 filter
OK this with HVAC designer
Conditions outdoor air
- 3) Install HRV with Filter \$\$\$
Balanced airflow
Energy efficient
Consistent ventilation

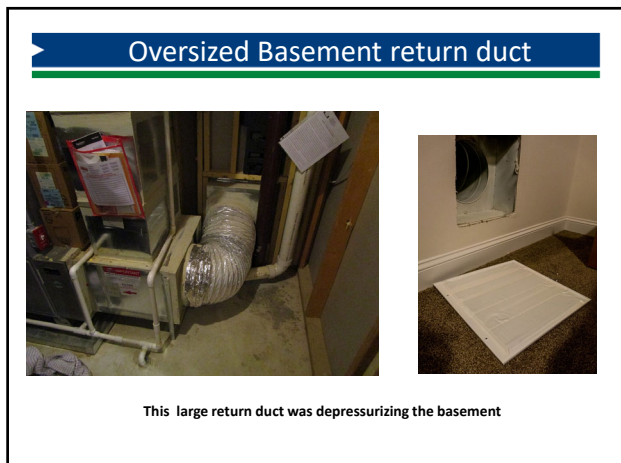
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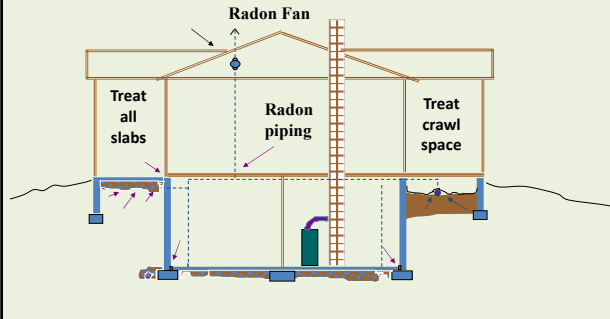


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Must treat combination foundations

Active Fan reverses pressure and causes house air to be sucked down

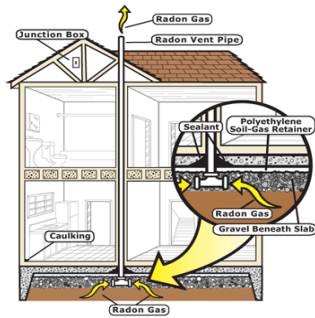
Radon piping even in garage slab if finished rooms above.



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Basic Elements of Appendix F

- Clean aggregate beneath all slabs
- Vapor barrier
- Minimum "T" fitting in the gravel
- Minimum 3" vent pipe from gravel to roof
- Seal all openings to the soil
- Install an outlet in attic for a future fan



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Superior Walls are problematic



Factory built Superior Walls

- No footers
- Has gravel drains to grade that need backwater stops
- Slab not poured into cavities
- Basement is often finished with no edge seal
- Requires high airflow 4" radon system
- Locate radon vent into center of basement & away from drains to grade

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Appendix F - Under the Slab

- 1) Minimum of 4" of clean #57 aggregate under the slab
- 2) Connect radon vent pipe to gravel bed (can use Sump Pit)
- 3) Install 5 feet of perforated piping on either side of Tee fitting



2B - #57 stone is the best



Slotted Corrugated



Rigid perforated



Optional
Geotextile Fabric

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Where to Locate Radon Pipe



Avoid locating radon vent pipe
near walk out side of the basement



Don't drain access window into
basement gravel or sump

*** Keep radon vent pipe away from
drains to grade ***

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Sub-Contractors often bury Radon Pipe!



Radon vent pipe
jammed in the dirt



Radon Pipe installed
below the gravel

*** Install minimum 5 feet of perforated
pipe on either side of Tee ***

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Sump pit depressurization



- Sump pit must be connected to gravel
- Sump pit lid must be sealed with silicone caulking
- If pit has a pump, a four inch access port is required
- New ANSI/AARST code does not allow sump pit suction

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Appendix F - Soil Gas Retarder

- 1) Minimum 6-mil polyethylene or equivalent or 3-mil cross-laminated placed on top of gravel.
- 2) Cover the entire area and over lap seems by at least 12 inches
- 3) Seal around any penetrations. Seal or cover any membrane tears



**New
ANSI/AARST
code requires
sealing
all edges**

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Must seal plumbing block outs



Showers require sealing before pan is installed



One inch cement coating is enough

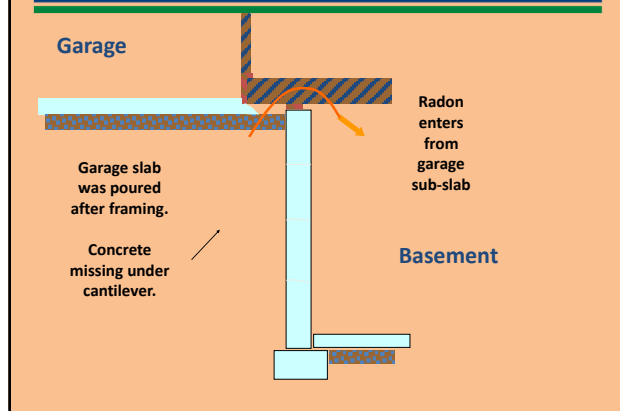
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Perimeter slab edge needs caulking



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Cantilevered floors increase Radon



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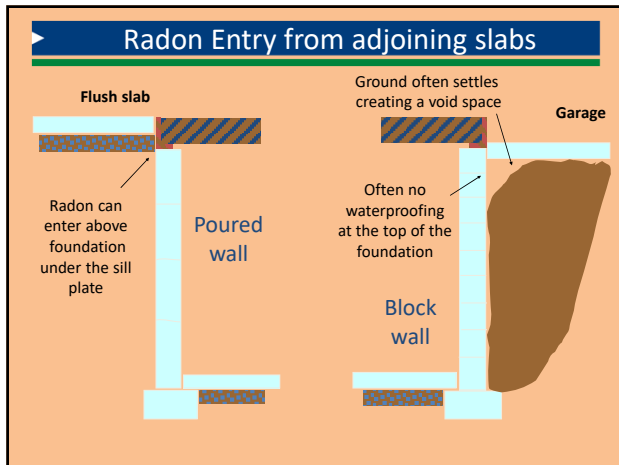
Avoid soil to basement openings

Cantilever creates a small crawl space with direct opening to the basement

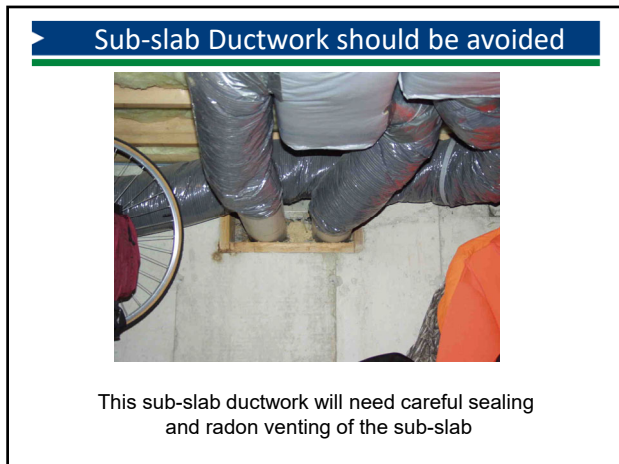


Radon easily moves from garage gravel to the basement

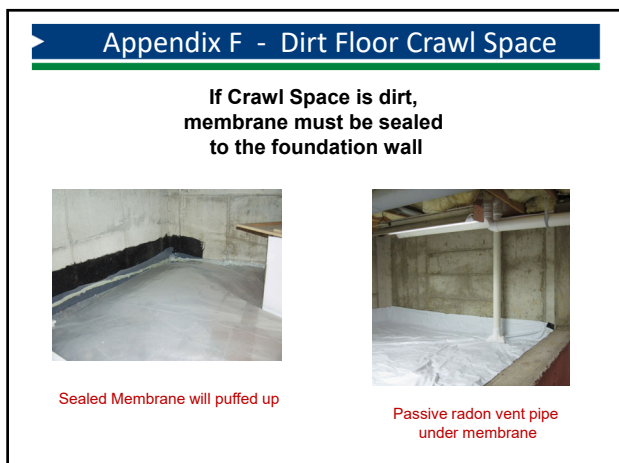
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ANSI/AARST vent pipe size

Vent pipe size	Total area of treated ground contact
3 inch	Up to 2500 sq.ft.
4 inch	Greater than 2500 sq.ft.



Can use two
3" vent pipes
in place of 4"

Avoid
routing pipe
in
insulated
walls

Include
Radon Vent
Label
on each floor
& attic



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RRNC problems

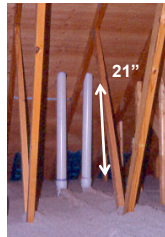
Do not route pipe
above cathedral
ceiling with no attic



Pipe must be
accessible
In attic

Must have
electrical outlet
less than 6 feet
from pipe

Pipe must have 21"
vertical for future fan



Label radon pipe
in the attic

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No Fan allowed in Conditioned Attic

Some homes are
being built with
conditioned attics

Can not install
the radon fan
in this conditioned
attic space



Must route radon pipe
to garage attic
or outside system

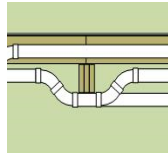
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Appendix F - Piping in the Attic

Consider having a combination plug and light at the future fan location



Vent piping needs to drain.



No water traps

ANSI/AARST
Horizontal supports less than 4 ft apart



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Consider having an Active System

Standard radon fans consume only 20 to 60 Watts



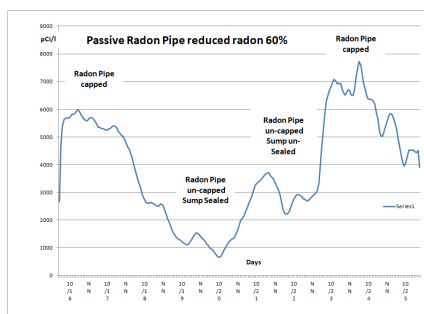
Fan installation requires a visible gauge



Breaker must be labeled "Radon Fan"

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Passive radon pipe capped & uncapped



Bottom of passive vent pipe capped & uncapped in Sump



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Optimized Passive Radon System

- Loop of perforated in clean gravel
- Slab carefully sealed
- Vent pipe installed in interior walls
- System exhaust close to roof ridge
- HVAC system is balanced
- Provide mechanical outdoor air
- Reduce Thermal By-Passes

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Most Common RRNC problems

- Vent pipe jammed into dirt. No suction is achieved.
- Crawl space or slab not treated
- Vent pipe exhausts within 10' of window or skylight
- Perimeter of slab or plumbing block out is unsealed.
Basement is now finished !
- Styrene Fittings attached to PVC piping with wrong glue
- No space or access in attic to install a fan
- No outlet in the attic to power the fan

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Thanks for attending Contact information

Bob Lewis - PA DEP Radon Division

(717) 783-3594 or (800) 267-2366

rolewis@pa.gov

<https://www.dep.pa.gov/business/radiationprotection/radondivision/Pages/default.aspx>

Bill Brodhead WPB Enterprises, Inc.

(610) 613-8004

wmbrodhead@gmail.com

www.wpb-radon.com Google "Bill Radon"

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