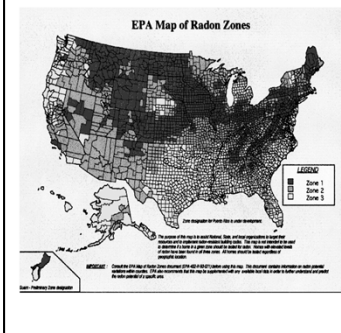


Radon Resistant New Home Construction (RRNC)



- Passive Systems
- Cost-effective
- Recommended for Zone 1 areas.
- Appendix F of the IRC
 - Required in many jurisdictions

Radon Resistant New Construction

Topic 8 - Audio 64

Key Points

EPA Map of Radon Zones

- Designations drawn in by county boundary to match code jurisdictions
- Indicates the potential for a short-term measurement in the lowest portion of the home to fall within a given range:
 - Zone 1: Greater than 4.0 pCi/L
 - Zone 2: Between 2 and 4 pCi/L
 - Zone 3: Less than 2.0 pCi/L
- It does not mean the average of readings are within a range or all readings are within that range. It merely means that the probability is high enough to justify the incorporation of RRNC into new home construction.
- Soil testing has not proven to be a good predictor of radon in a future home-the map or knowledge of frequency of elevated homes in area is best indicator.

International Residential Code, Appendix F

- Incorporates Zone Map as areas where RRNC recommended
- System to allow for passive ventilation of radon, with means to activate with the installation of a fan.
- Each jurisdiction must decide if it will adopt Appendix F (either as is or with modifications).
- Just because the IRC may have been adopted it does not mean that Appendix F has been adopted.
- Prescriptive method for installing systems - not performance based
 - Testing should be done after home is completed to verify reductions - Best done after occupation and house lived in

Why Not Wait Until Home Is Finished?

- You can incorporate features that may eliminate need for fan.
 - Sub-grade can be made more permeable during construction.
 - Routing pipe through warm chases can create natural stack effect.
- Vent can be hidden in chases to improve looks.

Many of the same details already covered in this text are included within this approach, however they are applied differently or more extensively since they can be done during construction.

RRNC – Aggregate Option

- Make sub-grade permeable to enhance soil gas collection.
- Ensure soil gas flows through subgrade to single riser.
- Used when aggregate is inexpensive or already required.

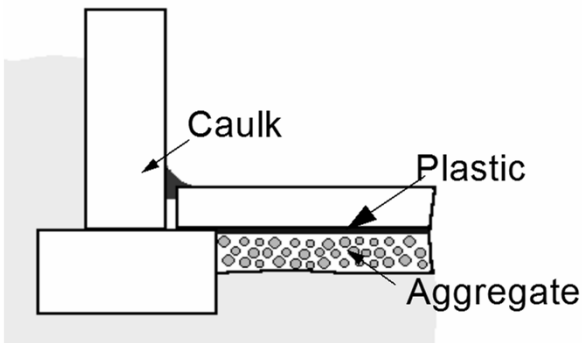
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Radon Resistant New Construction

Topic 8 – Audio 65

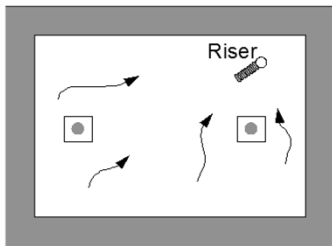
Key Points

Aggregate Option

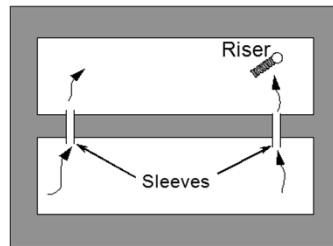


A uniform layer of clean aggregate, a minimum of 4 inches (102 mm) thick. The aggregate shall consist of material that will pass through a 2-inch (51 mm) sieve and be retained by a 1/4 -inch (6.4 mm) sieve. A uniform layer of washed gravel will provide a path for radon to flow through provided it is not obstructed by intermediate footings or concrete that sinks into the voids within the gravel layer. (IRC App F)

- Plastic sheet between aggregate minimum 3 mil poly or 6 mil cross-laminated.

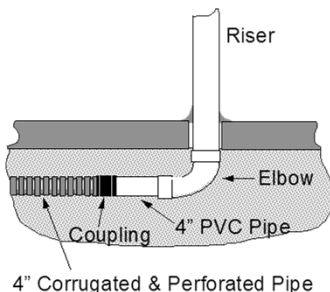


Plan View
Post and Beam



Plan View
Foundation with Grade Beam
For Bearing Wall
One /10 feet minimum 2 sleeves

- If post and beam construction, soil gas will pass from far length of slab.
- If there are grade beams or intermediate footings, use pipe stubs to allow soil gas to flow from all areas of the sub-grade to collection point.
- Locate collection point for optimal routing of vent pipe up through interior of building.



Riser can be a PVC "Tee" in gravel, however many contractors have found a short length of perforated pipe (10 feet) will enhance collection of soil gas and prevent the vent pipe from being filled with aggregate. It is suggested that perforated pipe be wrapped in a filter fabric cloth to keep fines from plugging holes.

RRNC – Perforated Pipe Option

- Continuous loop of perforated pipe.
- Reduces distance soil gas must move.
- Used where aggregate is expensive and not called out.
 - Typically where native soils drain well.
- Independent of drainage systems.



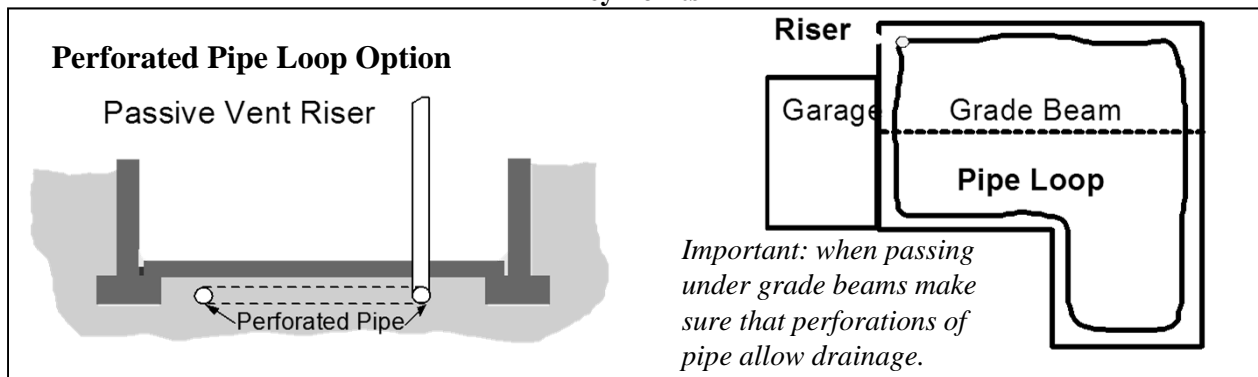
• Pipe laid in subgrade with approximately 1-inch of fill above.
 • Pass loop through intermediate footings

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Topic 8 - Audio 66

Key Points



A foundation drain pipe system installed under concrete floor slab areas less than 2,000 square feet (186 m²), consisting of a continuous loop of minimum 3-inch (76 mm.) diameter perforated pipe shall be laid in the sub-grade with the top of pipe located 1 inch (25.4 mm) below the concrete slab.

The pipe may be rigid or flexible but shall have perforations fully around the circumference with a free air space equal to 1.83 square inches per square foot (127 cm²/ m²) of exterior pipe surface area. Such pipe shall be wrapped with approved filter material to prevent blocking of pipe perforations.

The pipe loop shall be located inside of the exterior perimeter foundation walls not more than 12 inches (305 mm) from the perimeter foundation walls.

In buildings where interior footings or other barriers separate the sub-grade area, the loop of pipe shall penetrate, or pass beneath such interior footings or barriers. (IRC App F)

Footprint (S.F.)	Loops	Diam.		Loops	Diam.
Up to 2,000	1	3"			
2,000 to 4,000	1	4"	or	2	3"
4,000 to 6,000	2	3"			
8,000	2	4"			

Loops should be inter-connected

Bring loop together to solid PVC Tee that is connected to vent system.

RRNC: Mat Option

- Minimum 1 inches high & 12 inches wide.
- Lay mat directly on subgrade
- Pour concrete over mat

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Topic 8 - Audio 67

Key Points

Drain Mat Option

- Laid in a rectilinear loop on sub-grade
- Be sure to maintain minimum 3.5 inches of concrete above mat.

Note: a minimum of 3.5 inches of concrete must be maintained

AF103.2 Option 3:

A foundation drain soil gas collection mat system installed under concrete floor slab areas of 2,000 square feet (186 m²) or less, consisting of a continuous rectilinear loop of soil gas collection mat or drainage mat having minimum dimensions of 1 inch in height by 12 inches in width (25.4 mm in height x 305 mm in width) and a nominal cross-sectional air flow area of 12 square inches (0.0078 m²) may be laid on top of the sub-grade. The mat shall be constructed of a matrix that allows for the movement of air through it and be capable of supporting the concrete placed upon it. The matrix shall be covered by approved filter material on all four sides to prevent dirt or concrete from entering the matrix.....All breaches and joints in the filter material shall be repaired prior to the placement of the slab. The loop shall be located inside the exterior perimeter foundation walls and within 12 inches (305 mm) from the perimeter foundation walls. In buildings where interior footings or other barriers separate the sub-grade area, the mat shall penetrate these interior footings or barriers to form a continuous loop around the exterior perimeter. (IRC App F).

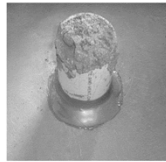
<ul style="list-style-type: none"> • <i>Run mat through grade beams</i> • <i>This can be done with short pieces and then spliced or all at once.</i> 	<ul style="list-style-type: none"> • <i>Corners & splices made by cutting and overlapping mat.</i> • <i>Follow manufacturer instructions</i> 	<ul style="list-style-type: none"> • <i>Use landscape staples to hold mat down, until slab is poured</i> 	<ul style="list-style-type: none"> • <i>Bring opposite ends of loop to special riser, to which vent pipe is later attached.</i>

RRNC: Sealing



Secure riser, so it is not tilted during concrete pour

Temporarily cover end of riser to keep concrete and construction debris from entering and disabling system



- Short stub for vent.
- Secure in place.
- Tape over end to keep concrete out.
- Seal around joint after concrete cures.
- Connect to pipe when running vent.
- Label it!

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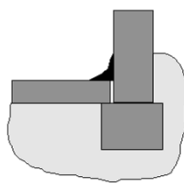
Topic 8 - Audio 68

Key Points

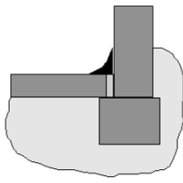
Regardless of the sub-grade gas collection method used, you will have a short stub of pipe sticking up to which the vent piping system will later be attached. Care should be taken to:

- Cover the end of the pipe so it does not become filled with concrete when the slab is poured.
- Label so someone does not mistakenly think it is tied to the sewer and set a commode on it.
- Support it off a wall so it stays vertical as the wet concrete is poured.

Sealing Slab Openings



Cold Joint



Expansion Joint

Seal Slab Openings

- Polyurethane caulk
- Cold joint: 12 feet per 11 oz. tube
- Expansion Joint: 8 feet per tube
- Control joint: 8 feet per 11 oz. tube
- Plumbing penetrations
- Sealed-yet removable cover on sump
- Plumbing Block-outs



Plumbing block-out insert



Parge exterior walls (required in most areas for other purposes)

Block Walls

- Barrier to vertical flow at point above grade
 - Continuous course of solid masonry, or
 - One course of fully grouted block
 - Solid beam above grade

Brick Veneer

- Course immediately beneath brick ledge to be sealed

RRNC: Routing Vent Pipe



Hide in chases and walls



Route along side flue for maximum stack effect

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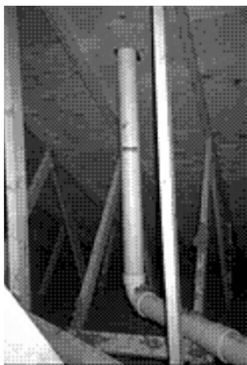
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Topic 8 - Audio 69

Key Points

Route vent up through warm space.

- In same chase as flue is a good method-maintain proper separation
- Do not connect to flues or plumbing vents.
- Causes chimney effect that helps draw slight vacuum on soil gas.
 - Reduces need for fan.
- Don't run up outside wall
 - Less effective and no room for future fan, if needed.
- Other Considerations
 - Cover the end of the pipe so it does not become filled with concrete when the slab is poured.
 - Label so someone does not mistakenly think it is tied to the sewer and set a commode on it.
 - Support it off a wall so it stays vertical as the wet concrete is poured.
- Vent Pipe
 - Schedule 40 PVC or ABS
 - Minimum diameter: 3-inch
 - Do not trap (run like you would vent system for existing homes previously discussed).



Passive



Active

Make Provisions for Future Fan

- *Allow 30-inches of vertical space outside of living space*
- *Junction box or other means to power fan*
- *Potential future performance indicator.*

RRNC: Discharge End & Labeling



- Penetrate roof decking before shingles installed
- Put rodent screen on end
- Minimum of 12 inches above roofline.



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Key Points

- Route vent pipe up through decking
- Roofer can flash and finish
- Terminate 12-inches above roof
- Try to locate on back side of ridge and near peak
- Maintain distances from other building openings as dictated in the EPA Mitigation Standards.
- Put rodent screen on end to prevent entry of birds and debris.



Terminate 12 inches above roof

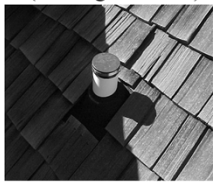


*Label all portions of visible pipe
"Radon Reduction System"*


- *A system label to be located in a portion of the home advising occupant of the existence of a radon system.*
- *A good place might be near the circuit panel or on wall near visible portion of pipe in utility room.*
- *Advises testing as a means to assure low exposures and need to potentially activate system.*
- *Reduces your liability*

How Well Do Passive Systems Work?

Capped System
(unmitigated level)



Uncapped
Passive system operating



- Measure house with system capped (assumed unmitigated level)
- Measure house with passive system operative
- In some cases houses measured with system activated

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Topic 8 - Audio 71

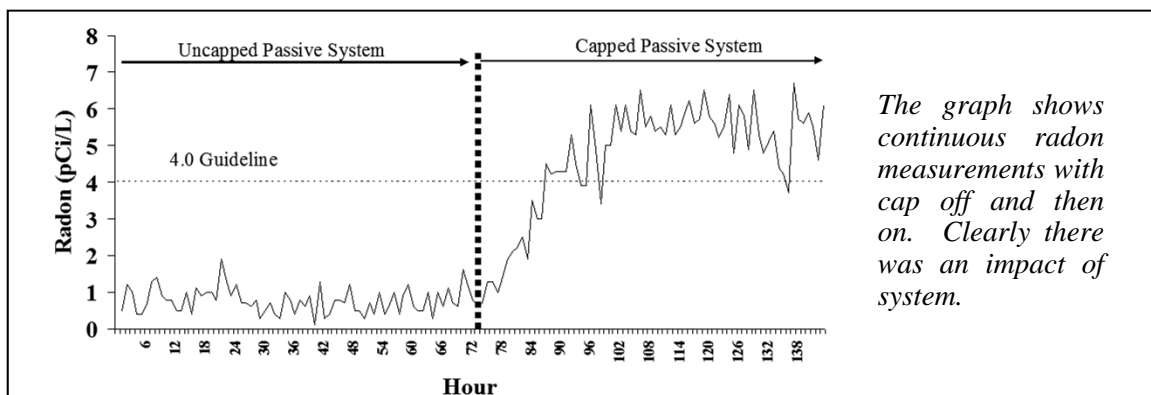
Key Points

- Research has been at a number of locations in the country, where newly constructed homes with passive radon systems were tested with the vent capped and uncapped.
 - Assumes capped result is what house would have been with no radon system.

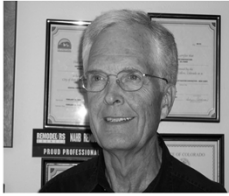
Description	Number	Notes
Homes reviewed	117	All but 5 in Zone 1
Mean Capped Measurements	6.8 pCi/L	
Mean Passive	3.4 pCi/L	Average 51% Reduction
Homes where capped results > 4.0	60	51% of total
Number of homes where passive system reduced radon to < 4.0	33	55% success for those > 4.0
Failure of passive systems where capped results were > 4.0	27	45% of those > 4.0 pCi/L
Homes where passive system was not necessary to reduce to less than 4.0	57	49% of total

} 28%

- On the average, these studies have shown a 50% reduction in radon
- Not all homes reduced to less than 4 pCi/L.
 - Failures were due to vents in exterior walls (no stack effect)
 - Insufficient sealing
 - Vents into attic rather than up through roof.
- Need to test homes to verify reductions
 - Labels & Disclosure documents advisable.



Gil Paben



- Aspen Construction Enterprises

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Key Points

Radon Resistant New Construction

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Advice:

- Become familiar with building trades.
- Recognize that time is of the essence for builders to keep projects on track.
- Be professional.

Approaches with Builders

- Builders have a lot to do and also are subject to a lot of regulations.
- Soft sell RRNC and recognize builder's viewpoints and challenges
- Radon Resistant New Construction (RRNC) is a value-added feature. The trend is continuing to grow where buyers perceive RRNC as a value.
 - Protect family-especially children in lower level play areas
 - Helps builder sell home
 - Helps buyer sell home in the future.
 - Liability reduction for builder
- Be a resource. Educate builders
- Systems are more aesthetically pleasing when installed during construction rather than after construction.

Appendix F of the 2003 International Residential Code

- Passive system that vents soil gas through the roof.
- Seal foundation (plastic in crawl space)
- Test after house finished and occupied.
- Activate with fan if levels are not reduced sufficiently.
- Not required in all jurisdictions-but where not, Appendix F provides a good prescriptive specification to follow.

Coordinating Installation

- Work within builders schedule
- Coordinate with other trades
- Schedule everything and spell schedule out in proposal
 - *Sub-grade*: After sub-grade plumbing in
 - *Vent pipe*: After HVAC. Interior plumbing and electrical installed
 - *Slab caulking and crawl plastic*: Before carpet installation and after interior clean-up

Costs:

- Will require multiple trips to site.
- Can cost more than retrofit-but appearance and potentially not needing fan can justify cost.
- Having passive RNC in conjunction with other HVAC improvements in new homes can reduce need for fan (some builders prefer going right to active systems).