

Proposed Radon Hazard Subcode for New Jersey Schools Buildings

Revised 1/18/07 draft

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RHSSB 10-1 Title, scope; intent

- (a) This part of the regulations shall be known and may be cited throughout the regulations as “Radon Hazard Subcode for School Buildings” (RHSSB) and, when referred to in this subchapter, may be cited as “this subchapter” or “RHSSB”.
 - 1. This subchapter is intended to complement rules adopted by the New Jersey Department of Environmental Protection at N.J.A.C. 7:28-27, which provide for certification of persons who sell radon or radon progeny devices, test for radon or radon progeny, or mitigate radon in buildings.
- (b) This subchapter pertains to the construction of all Group E buildings, as defined in the building subcode, within the radon area defined as Tier One by the New Jersey Department of Environmental Protection and shall define regulations relating to construction techniques to minimize radon gas and radon progeny entry and facilitate any subsequent remediation that might prove necessary.
- (c) This subchapter seeks to protect and ensure public safety, health and welfare insofar as it is affected by radon entry into schools.
 - 1. Radon is a colorless, odorless, tasteless, radioactive gas that occurs naturally in soil gas, underground water, and outdoor air. Prolonged exposure to elevated concentrations of radon and its progeny (that is, substances formed as a result of the radioactive decay of radon) has been associated with increases in the risk of lung cancer. An elevated concentration is defined as being at or above the guideline of 4.0 pCi/L average annual exposure..
 - 2. The construction requirements in this sub-chapter are not intended to preclude voluntary use of additional or more extensive techniques. Any or all of the construction techniques listed in this sub-chapter are permitted to be incorporated in areas of New jersey outside of Tier One.
 - 3. Existing Group E buildings shall not be subject to the construction techniques or material requirements set forth in this subchapter

RHSSB 10-2 Definitions

The following words, terms and abbreviations, when used in this subchapter, shall have the following meanings unless the context clearly indicates otherwise.

“AASHTO #57” – The American Association of State Highway and Transportation Officials grading system for stone that requires 90-100 percent of the stone to pass through a 1” sieve, 25-60 percent must pass through 1/2” sieve and 0-10 percent must pass through a No. 4 sieve.

“Cracks” - Openings in the slab or foundation that are 1/32” or greater.

“Gravel” - Crushed rock, aggregate or gravel that is used to support a concrete slab and still allow drainage and airflow under the slab. The words gravel, aggregate and crushed stone are used interchangeably throughout this subchapter.

“Gravel bed” - A bed of gravel under a concrete slab. The area of the gravel bed is the square footage of ground contact contained within the perimeter foundation walls, footers or other perimeter obstructions to the airflow beyond the gravel bed area.

“Perforated Piping” – Rigid plastic piping at least 3” in diameter that is a minimum schedule 20, with at least two 5/8” diameter holes in the pipe, every 5”. Each set of two holes are typically drilled 120 degrees apart from each other.

“Pecocurie per liter (pCi/L)” - pCi/L is equal to 2.2 disintegrations per minute of radioactive material per liter. It may be used as a measure of the concentration of radon gas in air. One picocurie is equivalent to 10^{-12} Curies.

“Radon” - The radioactive noble gas radon-222.

“Radon progeny” - The short-lived radionuclides formed as a result of the decay of radon-222, including polonium-218, lead-214, bismuth-214 and polonium-214.

“Radon Vent Piping” - Gas and water tight pipe and fittings used to vent radon from the soil to a location outside the building.

“Utility Trench” - A shallow concrete trench just below the top of a slab that is used to route piping or conduit. The utility trench typically has removable panels on top of the trench that are flush with the concrete slab.

RHSSB 10-3 Enforcement

- (a) The provisions of this subchapter shall be enforced by the agencies having responsibility for the enforcement of this sub-chapter.
- (b) Enforcement responsibility shall be divided among subcode officials in the following manner:

For new structures and additions:

- i. Except as otherwise indicated in (b) 1ii below, plan review and inspection with regard to compliance with RHSSB 10-4(b) shall be the responsibility of the building subcode official;
- ii. Plan review and inspection with regard to work performed under RHSSB 10-4(b) that is otherwise subject to the plumbing, electrical or fire protection subcode shall be the responsibility of the plumbing, electrical or fire protection subcode official, respectively.

RHSSB-10.4 Construction techniques

- (a) Tier One radon hazard areas shall be identified in accordance with the county/municipal radon listing established by the Department of Environmental Protection. The current list of municipalities in Tier One areas is set forth in Appendix 1-A of this subcode.
- (b) The construction techniques set forth in this subsection shall be the minimum radon hazard protective features required to be incorporated into construction of buildings and additions in use Groups E in Tier One areas, and may be incorporated in other tier areas, in order to minimize radon and radon progeny entry and facilitate any post-construction radon removal that may be required. This sub-chapter is not intended to preclude voluntary use of additional or more extensive techniques.
1. Any foundation wall in contact with a gravel bed shall have all voids at the concrete slab elevation filled solid. If the interior slab is below the exterior grade, the masonry exterior foundation walls shall have, at an elevation above or at the exterior grade, all voids in one complete horizontal course filled solid with mortar. Any other openings into the exterior foundation wall below this level shall be sealed
 2. Any hollow core foundation walls that are in contact with a gravel bed on one side of the foundation shall have the below slab surface of the foundation wall on the gravel bed side and any foundation utility penetrations sealed with an appropriate sealer. Hollow core foundation walls with gravel beds on either side do not require foundation surface sealing as long as the voids are completely filled at the concrete slab elevation.
 3. A concrete slab shall be installed in all basements, slab on grade areas and crawl spaces.
 4. The concrete slab shall be at least 4 inches in thickness and shall completely cover the gravel bed. The concrete slab shall be tight to the foundation wall. Control joints cast into concrete slabs should use thin materials to facilitate later sealing.
 5. A continuous vapor barrier having at least the puncture, tear and moisture resistance of 6 mil thick (0.006 inch thickness) polyethylene shall be between all sections of the concrete slab and the gravel bed. Any seams in the barrier shall be overlapped at least 12 inches. Openings around the vapor barrier for utility piping or foundation supports shall be as small as practical. (need puncture tear and moisture resistance specifications for 6 mil poly)
 6. All gravel beds shall be at least six inches in height, consisting of aggregate, crushed gravel or crushed stone, no smaller grade size than AASHTO #57. Gravel bed height shall be maintained under any areas requiring a thicker slab.
 7. The total amount of gravel placed above and below any utility or radon piping installed in the gravel bed shall total 2 inches minimum in height.

8. All gravel beds shall be connected to a radon vent pipe routed to an approved location outside the building. Radon vent piping above the slab shall not terminate in a sump.
9. A gravel bed area that does not have a radon vent pipe can be considered connected to a radon vent pipe if PVC piping between the gravel beds or other equivalent means of connecting the gravel beds is provided. The minimum gravel bed connection is a four inch PVC pipe for each 40 linear feet of perimeter foundation/footer around the gravel bed area that has no radon vent pipe and/or a six inch PVC pipe for each 90 linear feet of perimeter foundation/footer around the gravel bed area that has no radon vent pipe.
10. Crawl spaces that have corrugated steel decking supporting the concrete slab above the crawl space shall be constructed in a manner to seal any openings between the gravel bed and the crawl space. Thickening the slab at the outer edge of the corrugated decking to cover the openings is an acceptable method for sealing the possible openings between the gravel bed and the crawl space.
11. Plastic piping and fittings installed above the slab shall be schedule 40 or greater. All plastic fittings and piping shall be made of the same material. Piping and fittings installed above the concrete slab shall be joined together as specified by the manufacturer's installation instructions.
12. Gas and watertight metal piping and fittings may be substituted if necessary to comply with code requirements. Inside diameters for metal pipe and fittings shall equal those specified for plastic radon vent piping. Metal piping and fittings will be joined together in an airtight and watertight manner as specified by the manufacturer's installation instructions.
13. Radon vent piping shall have at least the equivalent inside cross sectional area of a three-inch PVC pipe for venting gravel bed areas less than 1,500 square feet, at least the equivalent inside cross sectional area of a four-inch PVC pipe for venting gravel bed areas between 1,500 and 4,000 square feet, and at least the equivalent inside cross sectional area of a six inch PVC pipe for venting gravel bed areas between 4000 and 15,000 square feet. Radon vent piping shall be routed from a radon collection box or collection fitting to an approved location outside the building as specified in RHSSB 10-4,b-26. A single radon vent pipe exhaust can vent multiple gravel beds or be connected to multiple vent pipes from an individual gravel bed if the piping is sized according to the total gravel bed area the pipe is venting.
14. The collection fitting for gravel bed areas less than 1,500 square feet shall, as a minimum, be a three-inch "T" fitting embedded in the gravel bed with at least 2 feet of 3 inch perforated piping for every 100 square feet of gravel bed area. The perforated piping shall be attached to the "T" fitting and laid in the gravel bed with the holes facing down.

The collection box for gravel bed areas between 1,500 and 4,000 square feet shall be a plenum in the sub-slab gravel that is constructed by turning at least four open core 16 inch by 16 inch by 8 inch cement blocks on their side in a square so as to create an open plenum that is at least 14 inches by 14 inches

by 8 inches high. A six-inch or greater space shall be maintained between the support blocks. A radon vent pipe 4" or larger will be routed from inside this plenum to an approved exhaust location. See Figure 2.

The collection box for gravel bed areas between 4,000 and 15,000 square feet shall be a plenum in the sub-slab gravel that is constructed by turning at least six open core 16 inch by 16 inch by 8 inch cement blocks on their side in a square so as to create an open plenum that is at least 32 inches by 32 inches by 8 inches high. An eight-inch or greater space shall be maintained between the support blocks. A radon vent pipe 6" or larger will be routed from inside this plenum to an approved exhaust location. See Figure 1.

The collection box with approval from a design professional shall be covered with appropriate metal decking or pressure treated plywood or other equivalent covering to support the concrete slab.

As an alternative for the collection box a "T" fitting equivalent in size to the radon vent pipe above the slab can be placed in the gravel bed with 4" PVC perforated piping attached to each end of the "T" fitting. The perforated piping shall be at least 2 feet in length for every 100 square feet of gravel bed. The perforated piping shall be laid in the gravel bed with the holes facing down.

15. If the length of any gravel bed is more than 10 times the width of the gravel bed, then a perforated pipe with the holes facing down shall be placed in the gravel bed in place of a collection box. The perforated pipe shall be at least the length of the long length of the gravel bed minus the width of the gravel bed. The perforated pipe shall have the same or larger inside diameter as the radon venting pipe sized for the gravel bed.
16. Each collection box shall be located so that it is no more than half the distance from the center of the gravel bed to any outer edge.
17. Alternative gravel bed design, pipe size or collection plenum can be used if approved by a registered architect or a licensed engineer. The other system components and requirements shall still be required.
18. All cracks and control joints in any concrete slab including the intersection between the concrete slab and any foundation wall shall be sealed utilizing a non-cracking polyurethane caulk, or equivalent.
19. All concrete slabs shall be allowed to cure for at least 7 days before any crack or joint sealing is done. Interior walls shall not be installed over unsealed control joints or cracks.
20. Any cracks or openings through the concrete slab under Unit Ventilators shall be carefully sealed. Any unplanned openings or cracks in the foundation wall behind the unit ventilator shall also be sealed.
21. Floor drains, which allow soil gas to enter the building, shall be provided with removable stoppers or a radon gas resistant drain.

22. All sump installations that could allow soil gas to pass into an occupied space shall have a removable sump cover which substantially closes off the soil gas entry routes.
23. Any ductwork that is routed through a crawl space or beneath a concrete slab shall be properly taped or sealed to be airtight. No return ducts shall be installed in or below a concrete slab.
24. Openings or penetrations of the floor above any crawl space shall be substantially sealed in order to close off the soil gas entry routes.
25. Any entrance to a crawl space from an occupiable space shall include an airtight door. Other openings between any crawl space and occupiable space shall be substantially sealed.
26. All above slab plastic radon vent piping shall be adequately supported at least every 4 feet of horizontal run and 10 feet of vertical run or as specified by the manufacturers installation instructions. The pipe shall be routed in a manner that makes it accessible for the installation of a future in-line vent pipe fan above a flat roof or in a non-conditioned (not heated or cooled) space that has no occupiable space above it. All radon vent piping shall be installed in a configuration, and supported in a manner, that will ensure that rain water or condensate accumulation within the pipes will drain downward into the ground beneath the concrete slab and vapor barrier. The radon vent piping shall meet the following termination requirements:
 - i. Radon vent piping shall terminate at least 12 inches above a sloped roof or flat roof, measured from the highest point where the vent intersects the roof. Exception: Buildings more than three stories in height shall be allowed to terminate the vent pipe on the side of the building at least 20 feet above grade if there are no openings within 10 feet in any direction back into any portion of the building or any openings into an adjacent building. Any side exhaust outlet shall have aluminum or stainless screening with approximately 1/2" by 1/2" openings in the screen.
 - ii. No radon vent terminal shall be located directly beneath any door, window, or other ventilating opening of the building or of an adjacent building nor shall any such vent terminal be within 10 feet horizontally of such an opening unless it is at least 2 feet above the top of such opening. Radon vent terminals shall not be located within 20 feet of a building outdoor air intake grill. Radon vent exhaust shall be at least ten feet from any school lot line.
27. Radon vent piping shall be identifiable and clearly labeled at intervals of not more than 10 feet in all locations and not less than once in any room, space or concealed location.
28. A test fan shall be temporarily attached to the radon vent piping no sooner than 30 days after completion of the concrete slab. The fan shall be rated at no more than 400 cfm at one inch of static pressure for six-inch piping or a

maximum of 210 cfm at one inch of static pressure for four- inch piping or 110 cfm at one inch of static pressure for three-inch piping. 3/8-inch test holes will be drilled through the concrete slab at opposite ends of each gravel bed area that the activated fan is connected to. A digital differential pressure gauge capable of measuring a pressure difference of 0.001 inches of water column will be used to measure the pressure difference between the test hole and the room.

Each test hole shall have a negative pressure change induced by the fan that is at least 1.5 pascals or 0.006 inches of water column in strength. Only NJ certified mitigation specialists who are listed with the state as certified to do school mitigation can do the sub-slab pressure test. If this sub-slab negative pressure is not induced, additional sealing or radon vent piping shall be installed and additional pressure readings made to ensure the previously defined pressure is achieved.

29. In order to reduce stack effect, air passages that penetrate the upper portion of the conditioned envelope of the building, such as electrical or plumbing pipes, attic access openings, or other openings installed in top-floor ceilings, shall be closed, gasketed or otherwise sealed with materials approved for such applications.
30. If a passive radon vent stack is activated with a fan, it shall be installed outside or above the conditioned space by a state certified radon contractor. The fan shall have an electrical disconnect within eyesight of the fan. Weather resistant screen with 1/4" to 1/2" spacing shall be installed at the exhaust location. A system pressure indicator that indicates fan failure, that can be easily checked, shall be installed for each activated radon venting system. The sub-slab to building pressure differential at the corners of the gravel bed for each activated system shall be measured and recorded.

Illustration of a Radon Sub-Slab Collection Plenum Box

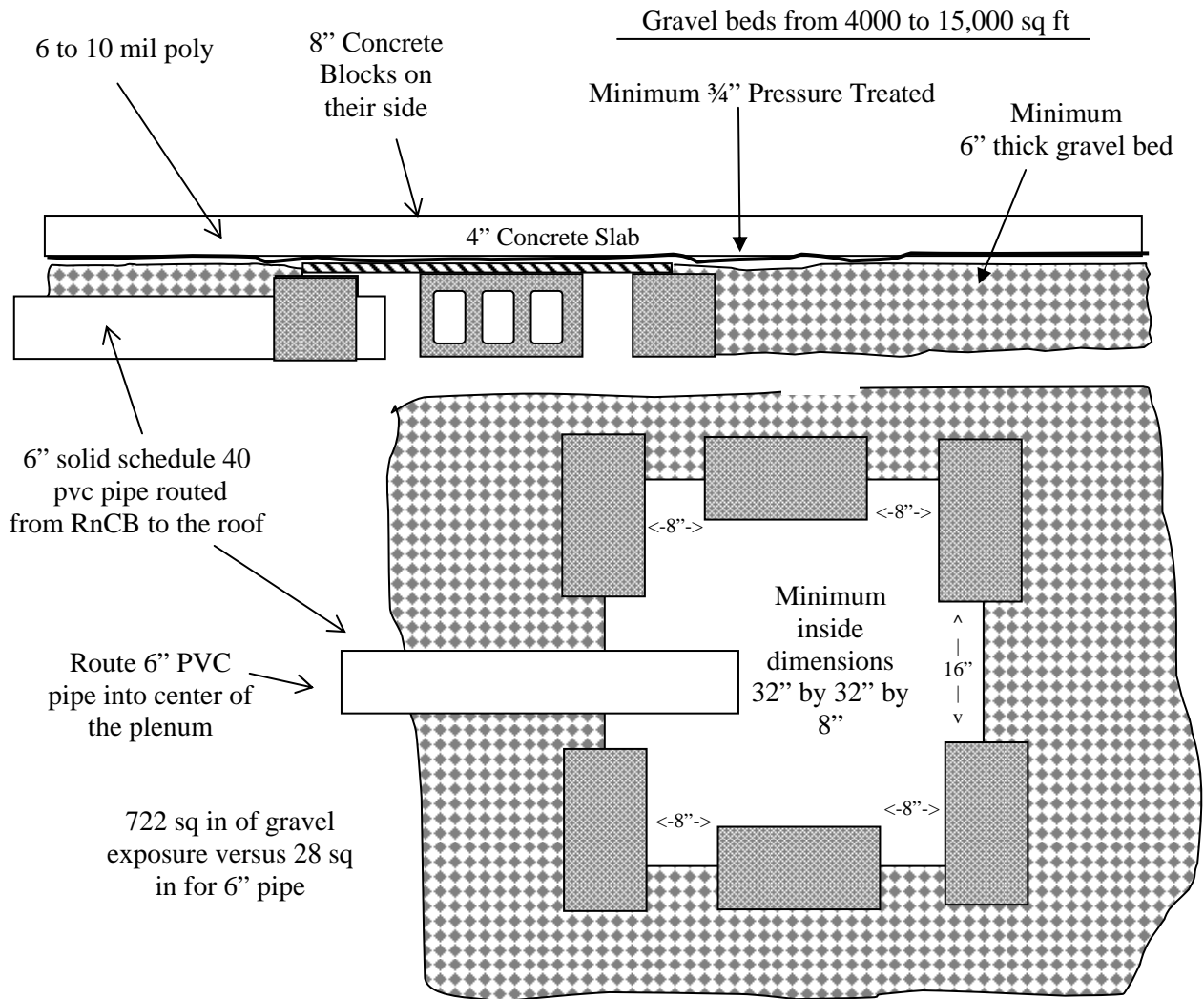


Figure 1

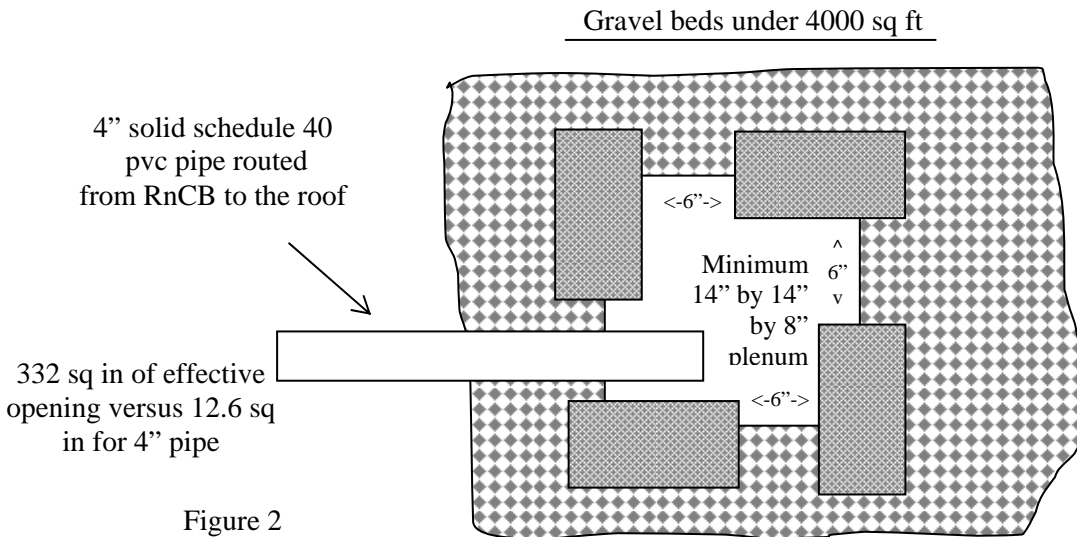


Figure 2