Radon Control for Part 9 Buildings

OVERVIEW

This guide is provided to assist in determining the installation requirements for radon control in buildings under Part 9 of the BC Building Code. On 2024-MAR-08, new requirements in the BC Building Code for protection from soil gases (which includes radon) came into effect for all areas in the province.

RADON

Radon is a colourless, odourless, radioactive gas that occurs naturally as a result of the decay of radium. It is found to varying degrees as a component of soil gas in all regions of Canada and is known to enter dwelling units by infiltration into basements and crawl spaces. The presence of radon in sufficient quantity can lead to an increased risk of lung cancer. The potential for high levels of radon infiltration is very difficult to evaluate prior to construction and thus a radon problem may only become apparent once the building is completed and occupied. Installation of a system to remove or reduce radon ingress would be difficult and costly after a building is finished; therefore, various sections of Part 9 of the BC Building Code require the application of radon exclusion measures.

RADON MITIGATION

An effective method for protecting buildings from elevated indoor levels of radon is to incorporate a subfloor depressurization system consisting of a gas-permeable layer under a continuous and sealed air/soil gas barrier, and a radon vent pipe with a fan that exhausts soil gases from the gas-permeable layer to the exterior of the building. **The current code requirement is for a rough-in to accommodate the future installation of a subfloor depressurization system. A rough-in consists of a gas-permeable layer, separated from the conditioned space, connected to a pipe that is ready for the installation of a fan.**

DEPRESSURIZATION SYSTEMS

The CAN/CGSB-149.11 Standard "Radon control options for new construction in low-rise residential buildings" identifies passive and active depressurization systems, which are described below. These systems provide options for removal of soil gas from below the building (if radon is identified after testing). It is important to note that the BC Building Code's references to CAN/CGSB-149.11 are limited to the following sections of the standard: pipe and fittings in accordance with 7.1.3., and location of the radon pipe termination as per 7.2.4.6. and 7.3.4. (see tables on page 5 in this document). The BC Building Code does not identify an active or passive system and requires only a rough-in system.

Passive Vertical Radon Stack for Soil Depressurization

A **passive** vertical radon stack system is created if the rough-in pipe system described in the BC Building Code (BCBC) is connected from the gas permeable layer under the ground air/soil barrier upwards through the building envelope and venting above the roof. The system relies on naturally occurring pressure differentials generated by the thermal stack effect (hence the term passive). Radon is pulled from the gas permeable layer-upwards inside the pipe stack and discharged above the roof. The BCBC does not require the pipe to exit through the roof, but allows optional locations for pipe termination; however, for a passive system to be effective, the pipe should terminate through the roof as detailed in 7.2.4.6. of CAN/CGSB-149.11.

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Active Soil Depressurization System

An **active** soil depressurization system is created if the rough-in pipe system described in the BC Building Code (BCBC) is installed with a radon fan to draw the air up the vent stack. An **active** system has a pipe exiting the building above the roof, or out a gable end or sidewall.

BC BUILDING CODE RADON CONTROL EXCERPTS

*For more detail, see **Notes to Building Code Requirements** below with corresponding red numbers, i.e.* **(#1)**

9.13.4. Soil Gas Control

9.13.4.2. Protection from Soil Gas Ingress

1. **(#1)** All wall, roof and floor assemblies or parts thereof, separating conditioned space from the ground shall be protected by an air barrier system conforming to Subsection 9.25.3.
2. Unless the space between the air barrier system and the ground is designed to be accessible for the future installation of a subfloor depressurization system, buildings shall
   a. be provided with a rough-in for a subfloor depressurization extraction system conforming to Article 9.13.4.3., or
   b. conform to Parts 5 and 6 for the protection from radon ingress and the means to address high radon concentrations in the future (see Articles 5.4.1.1. and 6.2.1.1.).

9.13.4.3. Rough-in for a Subfloor Depressurization System

1. **(#2)** Floors-on-ground shall accommodate the future installation of a subfloor depressurization system by installing a radon vent pipe, and a contiguous gas-permeable layer between the air barrier system and the ground consisting of
   a. a material or materials that allow effective depressurization of that space (see BCBC Sentence 9.16.2.1.(1)), or
   b. not less than 100 mm of coarse clean granular material containing not more than 10% of material that would pass a 4 mm sieve.
2. The radon vent pipe required by Sentence (1) shall
   a. be sealed to maintain the integrity of the air barrier system, with no perforations along the pipe above the air barrier system,
   b. **(#3)** have one or more inlets that allows for the effective depressurization of the gas-permeable layer (see Note A-9.13.4.3.(2)(b) and (3)(b)), and
   c. **(#4)** permit connection to depressurization equipment,
   d. **(#5)** where it passes through conditioned space, be completely surrounded by conditioned space,
   e. **(#6)** consist of pipe and fittings in accordance with 7.1.3 of CAN/CGSB-149.11, “Radon control options for new construction in low-rise residential buildings,”
   f. terminate outside the building in a manner that does not constitute a hazard,
   g. be installed to prevent the accumulation of moisture and away from locations where snow and ice accumulate, and
   h. be clearly labeled every 1.8 m and at every change in direction to indicate that it is intended only for the future removal of radon from below the floor-on-ground.

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BC BUILDING CODE RADON CONTROL EXCERPTS (cont'd)

9.13.4.3. Rough-in for a Subfloor Depressurization System

3. A radon vent pipe shall be deemed to comply with
   a. Clause (2)(b) where its inlet or inlets below the air barrier system are located at or near the centre of the floor-on-ground with gas-permeable material extending not less than 100 mm beyond any inlet, and,
   b. **(#7)** Clause (2)(f) where it terminates outside the building, not less than 1.8 m from a property line, and located in accordance with either 7.2.4.6. or 7.3.4. of CAN/CGSB-149.11, "Radon control options for new construction in low-rise residential buildings," with the opening of the pipe fitted with a corrosion-resistant screen or grille with a mesh opening size of 10 mm to 12.5 mm or a product of equivalent air flow performance. **Illustration F**

NOTES TO BUILDING CODE REQUIREMENTS

(#1) 9.13.4.2.(1) **conditioned space** means any space within a building the temperature of which is controlled over substantial portions of the year. Garages with uncontrolled temperature would not be considered conditioned space; therefore, living space over the garage would not need to meet radon provisions.

(#2) 9.13.4.3.(1) **contiguous gas permeable layer** can not be granular material that has been compacted.

(#3) 9.13.4.3.(2)(b) **have one or more inlets that allow for the effective depressurization** of the gas-permeable layer.

A-9.13.4.3.(2)(b) and (3)(b) Effective Depressurization. To allow effective depressurization of the space between the air barrier and the ground, the extraction opening (the pipe) should not be blocked and should be arranged such that air can be extracted from the entire space between the air barrier and the ground. This will ensure that the extraction system can maintain negative pressure underneath the entire floor (or in heated crawl spaces underneath the air barrier). The arrangement and location of the extraction system inlet(s) may have design implications where the footing layout separates part of the space underneath the floor. If an area is segregated by a footing (for example), a through-footing pipe can join the area so that a single suction point can depressurize both areas; however, for large buildings, it may be preferable to have multiple suction points. **Illustrations B & C**

(#4) 9.13.4.3.(2)(c) **permit connection to depressurization equipment** (radon fan) – allow sufficient space for future installation of an **active** system, a cylindrical space 1.200 mm (4') in height and 500 mm (1'6") in diameter is recommended in CAN/CGSB-149.11. Consideration should also be given to provision of electrical connection for equipment.

(#5) 9.13.4.3.(2)(d) **where pipe passes through unconditioned space** (e.g. attic) insulate to maintain the stack effect flow momentum and to minimize condensation on the inside of the pipe. It is recommended in CAN/CGSB-149.11. to avoid placing radon stack pipe on the exterior walls, in garages, and unheated crawl space.

(#6) 9.13.4.3.(2)(e) consist of pipe and fittings in accordance with **7.1.3. of CAN/CGSB-149.11**, "Radon control options for new construction in low-rise residential buildings".

(#7) 9.13.4.3.3(b) where the pipe terminates outside, it shall be located in accordance with either 7.2.4.6. or 7.3.4. of CAN/CGSB-149.11. Although **sidewall venting** is permitted if the clearances in table 7.3.4.3. are achieved, sidewall venting does not provide effective **passive** venting.

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Pipe and Fittings

7.1.3.1.1. Pipes shall have a nominal internal diameter of not less than 10 cm (4”).

7.1.3.1.3. PVC pipes installed completely or in part above grade shall comply with Schedule 40 specifications regarding wall thickness, inside and outside diameters and pressure ratings.
*Note: **CSA B181.2** “PVC DWV” (c/w grey solvent cement) and “CPVC DWV” (c/w clear solvent cement)*

7.1.3.1.4. Where vertical pipe is installed in the cavity of a wood-frame or steel-frame wall, the top and bottom plates and any horizontal framing members (such as blocking) shall have hidden steel **shield plate** installed to protect the pipe.

7.1.3.1.5. When pipe passes through a fire-rated wall or ceiling, the base of its penetration on its fire-rated side shall be fitted with an **intumescent collar** to maintain its fire resistance. **Illustration E**

7.1.3.1.7. Where horizontal pipe runs are necessary, pipes shall be supported as required by the local plumbing code for DWV piping, i.e. ABS or PVC plastic pipe **max 1.2 m** horizontal spacing of supports and at changes in direction. *Note: If horizontal runs are required, it is suggested that 22.5° fittings be used so that the stack momentum is maintained.*

7.1.3.1.8. Pipes shall be installed so as to minimize exposure to cold temperatures and shall be insulated where located in unconditioned space. Recommended in CAN/CGSB-149.11: sections of the passive stack passing through unconditioned space (e.g. an attic) shall be insulated to a minimum thermal resistance of 2.47 m^2K/W (**R-12**) to maintain the stack effect flow momentum and to minimize condensation on the inside of the pipe.

7.1.3.1.9. Horizontal pipes above and below ground shall be installed with at least a **1% slope** to return water to the soil.

7.1.3.1.10. The application of glues, cements, priming materials and pipe materials shall be selected according to the manufacturer's requirements for the applicable site conditions and service environment. All pipes, fittings, primer and cement products used in the same soil collector and suction point system shall be compatible.

7.1.3.2.1. PVC flue gas venting pipe and fittings shall meet the requirements of ULC S636 and all pipe, fittings and cement shall come from one manufacturer and the cement shall conform to manufacturer's specification and be adequate for the application conditions.

7.1.3.2.2. Pipe materials shall conform to ASTM F891, CSA B181.1 or ASTM F628., i.e. **ASTM F891** PVC cellular/foam core (c/w grey solvent cement), **CSA B181.1** “ABS DWV”, **ASTM F628,** ABS Schedule 40 plastic DWV with cellular core.

7.1.3.2.3. Pipes and fittings described in 7.1.3.2. shall be joined with products meeting the requirements of the respective pipe manufacturer.

7.1.3.2.4. Primer shall be applied where required.

7.1.3.2.5. PVC building drain sewer pipe shall meet the requirements of CSA B182.1 and shall conform to SDR 35 specifications. Fittings shall be made of PVC and conform to the requirements of CSA B182.1. Pipes and fittings shall be joined with PVC solvent cement meeting manufacturer’s specifications and application conditions. **This pipe shall only be used for below ground applications, this transition must occur below the slab or skim coat**, i.e. CSA B182.1 SDR 35 PVC sewer pipe (c/w grey solvent cement).

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The following termination clearances are required regardless of the notations passive or active in the table descriptions.

TABLE 7.2.4.6. – Minimum passive radon stack termination for roof top discharge.

Location	Required Minimal Clearances	
Vertical clearance above the roof at the point of penetration	0.3 m	1’-0”
Vertical clearance above windows or doors	0.6 m	2’-0”
Vertical clearance above mechanical air supply inlet (air intake)	0.9 m	3’-0”
Horizontal clearance from windows, doors or mechanical air supply inlet	3.0 m	9’-10”
Clearance horizontally from a vertical wall that extends above the roof penetrated	3.0 m	9’-10”

TABLE 7.3.4.3. – Clearance distances for active radon reduction systems

Location	Required Minimal Clearances	
Clearance to a mechanical air supply inlet	2.0 m	6’-7”
Clearance to permanently closed window	0.6 m	2’-0”
Clearance to an openable window	2.0 m	6’-7”
Clearance from a door that may be opened	1.0 m	3’-4”
Clearance to outside corner	0.3 m	1’-0”
Clearance to inside corner	0.3 m	1’-0”
Clearance above paved sidewalk or paved driveway located on public property	2.0 m	6’-7”
Vertical clearance below soffits or from any attic venting component	0.3 m	1’-0”
Horizontal clearance from an area directly below the discharge where there is risk of injury from ice fall	1.0 m	3’-4”

SYSTEM DESIGN

Additions and significant renovations or buildings/spaces being altered from unoccupied to occupied space (e.g. garage to living space) will be required to meet soil gas and depressurization system requirements. Alternative radon mitigation control measures should be reviewed with the Building Official prior to installation.

INSPECTIONS

Underslab radon rough-in pipe requirements will be inspected as part of the **Underslab Plumbing Inspection.**

- Granular material layer or alternative for future depressurization system
- Sealing of all air barrier joints/laps and edges to concrete
- Sealing around penetrations including electrical wiring, plumbing and HVAC
- Connection of pipes through separate compartments created by footings
- The rough-in pipe for a subfloor depressurization system
- If constructing a Hydronic heating system, inspection of the granular layer and review of the poly and subfloor depressurization system will need to be completed prior to the installation of insulation and heating tubes. An additional inspection may be required if the gas permeable granular layer will not be visible.

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INSPECTIONS (cont'd)

Granular material layer and the air barrier for radon control may be inspected at the **Underslab Insulation Inspection**, if not previously inspected.

Rough-in above slab radon pipe will be inspected as part of the **Rough-In Plumbing Inspection**.

- Piping type and location requirements are met
- Labeling of pipe every 1.8 m and at change of direction
- Exterior exhaust location has appropriate setbacks and clearances
- Future fan location with adequate room and connection to power

Insulation of radon pipe in unconditioned spaces will be inspected at the **Framing Inspection**.

QUESTIONS & ANSWERS

If I install a fan during initial construction, what are the code requirements for that fan?

The BC Building Code does not require a fan so there are no requirements specific to radon mitigation that the fan must comply with other than to be airtight. A fan installed along the radon vent pipe must maintain the air-tightness of the radon vent pipe and maintain the integrity of the air barrier system in order to limit leakage from the radon vent pipe into the building. CAN/CGSB-149.11 indicates fans be rated for continuous duty operation, conform to CSA C22.2 No.113 and be specifically designated by the manufacturer for radon mitigation.

How are buildings, other than dwelling units, protected against radon?

Buildings that do not conform to the provisions discussed in this guide must conform to environmental separation and ventilation requirements that are found in Parts 5 and 6 of the BC Building Code. Systems designed to Part 5 or Part 6 which minimize the ingress of airborne radon and other soil gases shall be designed by a registered professional who provides sealed design drawings and, if required by Division C 2.2.7.1., the associated Letter(s) of Assurance.

ADDITIONAL GUIDES AND PUBLICATIONS

Further information on protection from radon ingress can be found in the following publications:

- Radon Rough-in Requirements, Bulletin B24-03 March 8, 2024,Building Safety and Standards Branch
- Radon control options for new construction in low-rise residential buildings CAN/CGSB-149.11-2019
  Note the BCBC only references three sections of this Standard:
  1. pipe and fittings in accordance with 7.1.3.
  2. termination of a passive radon stack in accordance with 7.2.4.6.
  3. termination of an active radon stack in accordance with 7.3.4.
- Radon: A Guide for Canadian Homeowners, (CMHC/HC)
- Guide for Radon Measurements in Residential Dwellings (Homes), Government of Canada
- Radon, Canadian Cancer Society
- Radon and Lung Health, BC Lung Foundation

If you have any questions or require clarification, please contact Building Inspections at 250-755-4429.
This guide should not be used as a substitute for existing building codes and other regulations.
The building owner is responsible for compliance with all codes, bylaws, and other regulations.

ILLUSTRATIONS

Illustration A Radon piping from slab and crawl space through roof

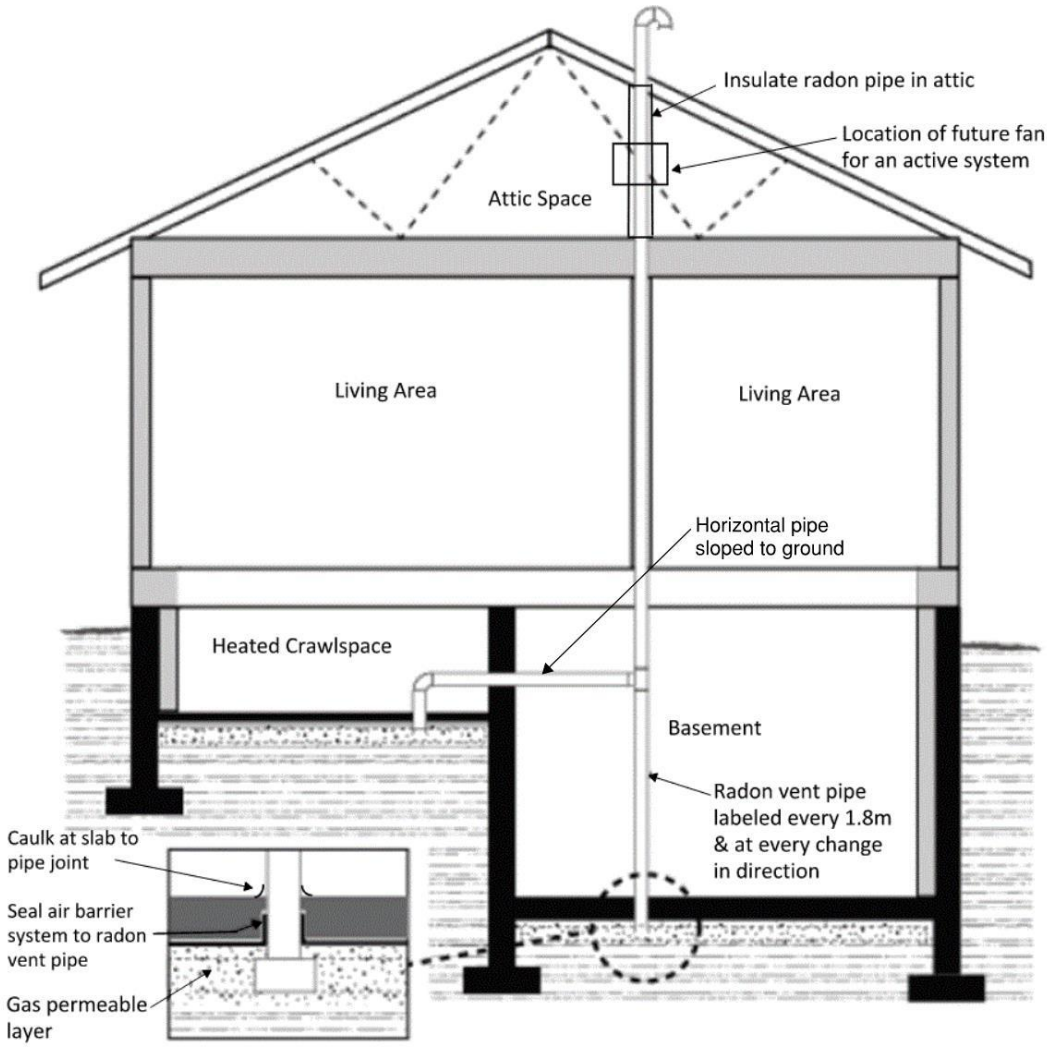

Illustration B Radon pipe rough-in placed below ground air/soil gas barrier

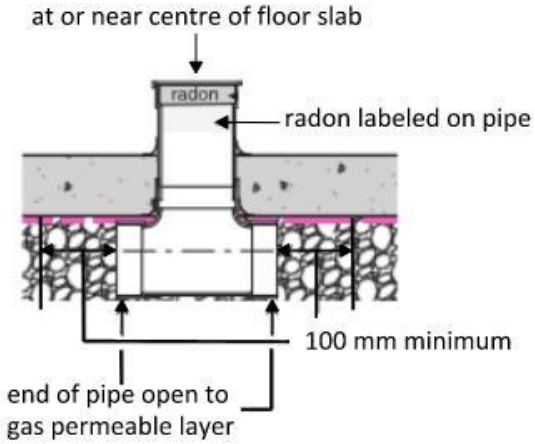

Illustration C Underslab radon pipe

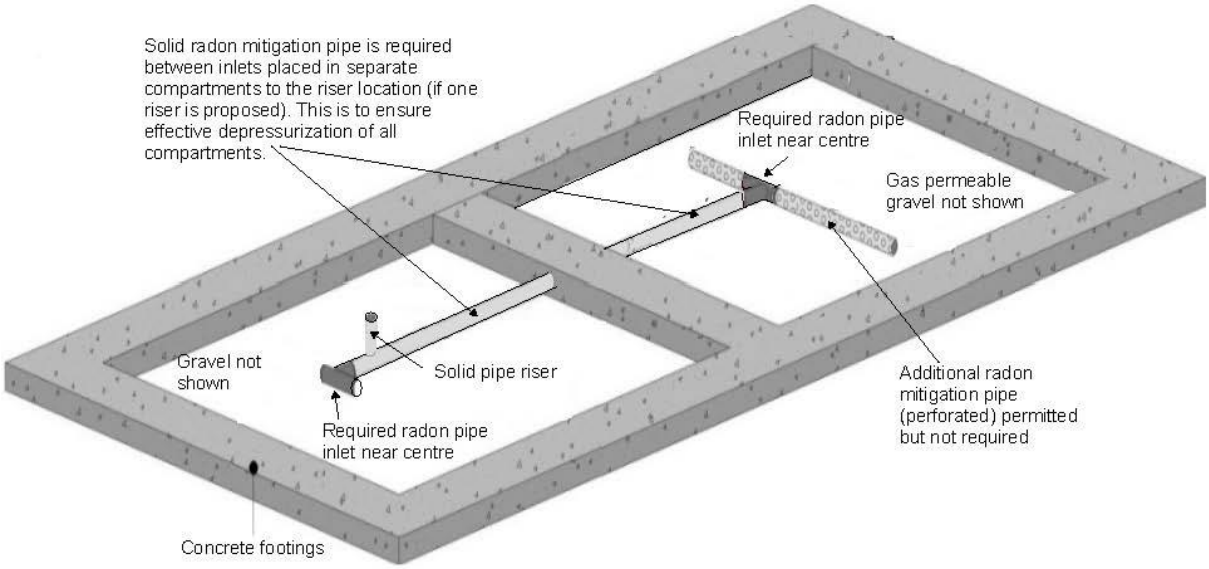

Illustration D Exterior foundation wall and radon depressurization rough-in

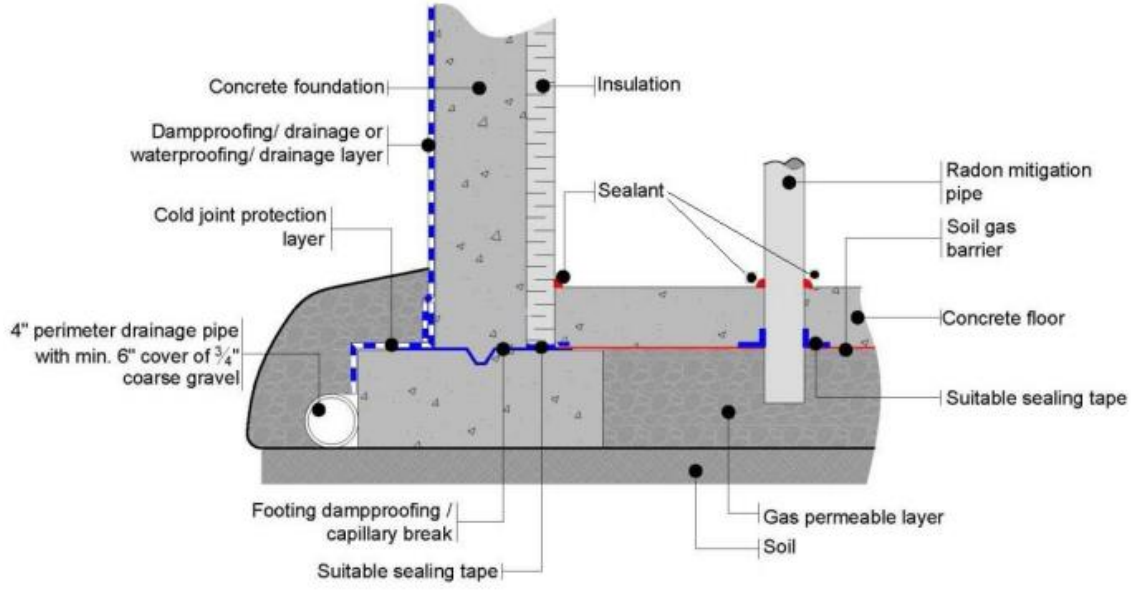

Illustration E

Pipe passing through a fire-rated wall or ceiling

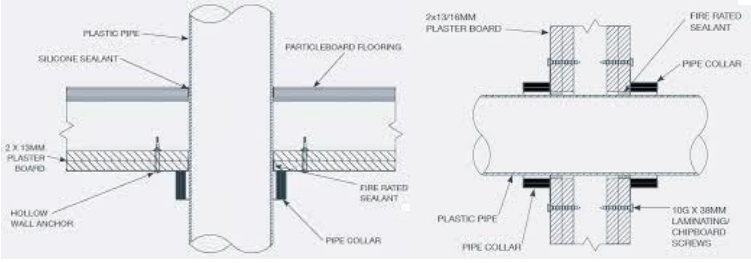

Illustration F

Pipe termination protection