UNDERLAYMENTS: Moisture Control

Moisture vapor moves through materials naturally. The more porous a material is, the easier it is for moisture vapor to diffuse through it. The function of a vapor retarder is to control the entry of moisture vapor in and out of building assemblies. Protection against moisture involves utilizing moisture control systems through the entire building construction design, from the exterior of the building to the interior building envelope, including the wood floor system.

A properly designed building, and quality construction practices, protect the interior living space against the infiltration of moisture, and the effects of seasonal humidity and temperature fluctuations between the inside and outside of the structure.

Vapor Permeance: A property that describes the ease with which vapor molecules diffuse through a material. More specifically, vapor permeance is defined as the quantity of vapor flow across a unit area that will flow through a unit thickness under a unit vapor pressure difference.

Perm Rating: The standard measure of the water vapor permeability of a material. The higher the number, the more readily water vapor can diffuse through the material.

Vapor Retarder (also known as a vapor diffusion retarder): A layer of material that is used to control the rate at which moisture can move through a material.

PART I
Vapor Retarder Classifications

The International Residential Code describes three classes of Vapor Diffusion Retarders (Class I, Class II, and Class III when tested in accordance with ASTM E-96 Test Procedure A – the desiccant or dry cup method):

A. **Class I** vapor retarder ≤0.1 perm. Class I vapor retarders are also considered Vapor Impermeable Membranes or Vapor Barriers.

B. **Class II** vapor retarder >0.1 perm and ≤1.0 perm. Class II vapor retarders are also considered Vapor Semi-Impermeable Membranes.

C. **Class III** vapor retarder >1.0 perm. Class III vapor retarders are also considered Vapor Semi-Permeable Membranes.

PART II
Vapor Retarders over Wood Subfloors

When installing wood flooring over a wood subfloor, identify if the space directly below the flooring is a conditioned space or an unconditioned space:

A. **Conditioned space** is an area or room within the building that is intentionally heated or cooled, and humidified or dehumidified, to be maintained at the same conditions as the living/interior space either for the comfort of occupants, or for preserving temperature and humidity-sensitive goods.

1. No vapor retarder is necessary over the wood subfloor and under the wood floor when the flooring is being installed over a conditioned space that is maintained at the same temperature and humidity as the living space directly above, unless otherwise directed by the flooring manufacturer.
2. No vapor retarder should be installed over the wood subfloor and under the wood floor, where a Class I or Class II vapor retarder has been installed on the underside of the joists.

B. **Unconditioned space** refers to exterior space or spaces within the shell of a building that is neither directly nor indirectly heated, cooled, humidified, nor dehumidified.

1. A Class II vapor retarder (sheet-good or liquid-applied) may be used on wood subfloors over unconditioned spaces to slow the rate at which potential moisture-laden air moves through the assembly and into the wood flooring, unless otherwise directed by the flooring manufacturer.
2. IMPORTANT: Never use a vapor retarder over a wood subfloor to remedy a known moisture condition, and never install a wood floor over a known moisture condition. A

known moisture condition is one that you are aware of, and could pose future damage to the flooring, the building, or the occupants. It is compulsory practice to always test for moisture regardless of conditions so that any unknown conditions can become known conditions, which then can be handled appropriately. The traditional standard for protecting wood and wood products from rot or decay is to keep the moisture content below 19 percent. Studies have shown, however, that mold growth can occur on wood at moisture content levels above 15 percent, and corrosion of metal fasteners can occur when moisture content exceeds 18 percent. Reaching these moisture content levels does not mean rot, decay, mold growth, or corrosion will occur, but does raise the risk for a potential problem. In all cases, it is important that the installer consult with all involved parties including the manufacturer and customer.

PART III
Vapor Retarders over Concrete Subfloors

A. Every concrete slab on- and below-grade should have a Class I vapor retarder installed directly beneath it, prohibiting the passage of ground moisture through the slab. If the vapor retarder below the slab has been compromised or left out, moisture will be able to move freely through the slab and into the flooring system. Unfortunately, there is no way of knowing whether there is an intact vapor retarder in place below the entire slab.

B. Moisture test the concrete substrate in accordance with the most current ASTM standards, to align the moisture control system and installation method with the condition of the slab. All moisture tests give a result "at the time the test was performed" indication, but do not give a permanent condition of the substrate. (See Moisture Testing chapter for more information.)

C. Install a Class I impermeable vapor retarder when calcium chloride readings are greater than 3 pounds, relative humidity readings are greater than 80%, or calcium carbide readings are greater than 2.5%.

D. In on- and below-grade applications, due to the ever-changing moisture variability with a concrete slab, and the likelihood of sub-slab moisture barrier degradation over time, a Class I impermeable vapor retarder is always recommended.

E. Depending upon your installation method, the type of vapor retarder will vary.
   1. Many vapor retarders are designed to be used in conjunction with compatible adhesives. When gluing down a wood floor, only use vapor retarders and adhesive systems that are compatible.
   2. Class I liquid-applied vapor retarders may include rolled- troweled- or sprayed-on sealers, epoxies, or urethanes. Follow the manufacturer's specific instructions on mixing, application, surface preparation, compatibility, moisture control limitations, and warranties.
   3. Class I underlayment sheet-good vapor retarders may include 6-mil polyethylene film or other premium polymer sheet goods, closed-cell foam pads, or peel-and-stick membranes. These sheet-goods must be laid flat on the subfloor, covering the entire surface, with no holes or penetrations. Follow the manufacturer's specific instructions on application, moisture control limitations, and installation methods.
   4. Multi-layer systems include using two layers of fabric membrane such as fiberglass mats, or asphalt-saturated felt or kraft paper. The first layer is adhered to the slab in a skim coat of an appropriate cold-stick asphalt-mastic or hot-mop adhesive, and the second layer is adhered to the first layer using the same fabric and adhesive.

PART IV
Vapor Retarders over other Substrates

A. Wood Subfloors over Concrete
   1. The vapor retarder should be placed over the concrete slab and underneath the wood subflooring. Follow the methods as listed in the Vapor Retarders over Concrete Subfloors section prior to installing any wood subfloors system over the concrete.
   2. With adequate moisture control over the concrete substrate, and below the wood subfloor system, there is no need for a vapor retarder over the wood subflooring.

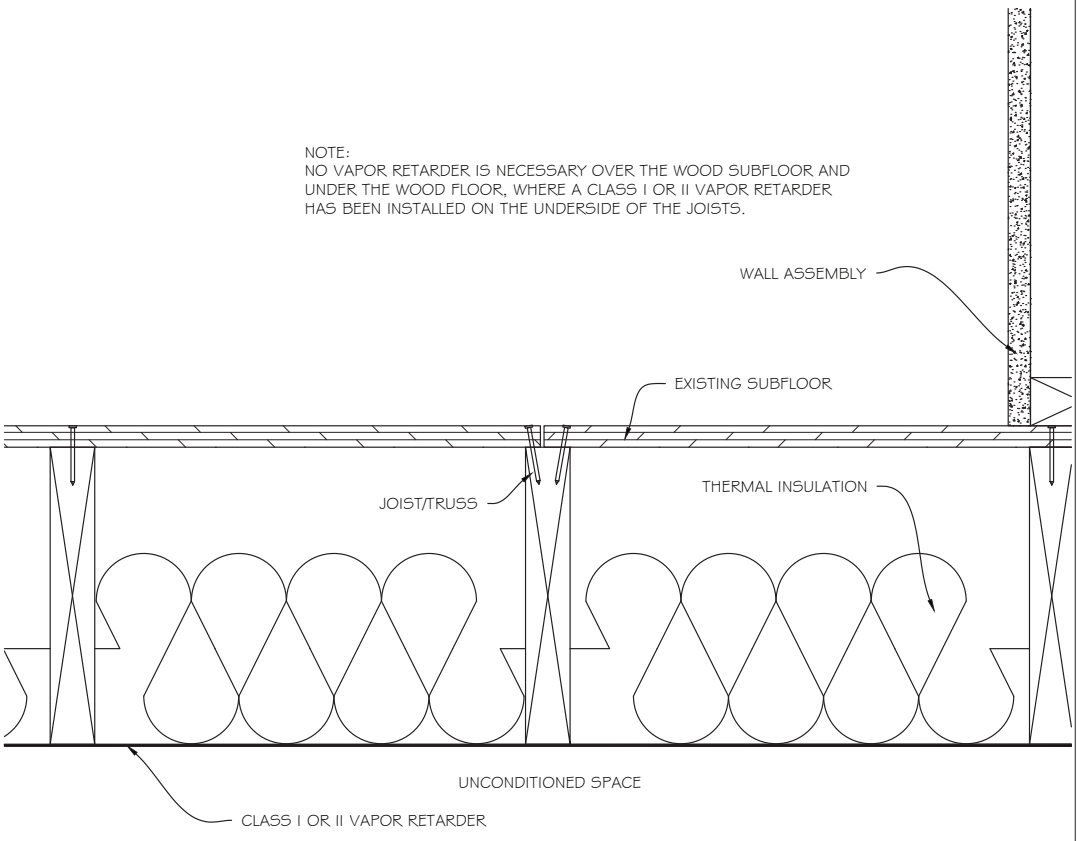
B. Screed/Sleeper Systems
   1. Follow the methods as listed in the Vapor Retarders over Concrete Subfloors section prior to installing any screed/sleeper system over the concrete.
   2. Where lightweight concrete mix or gypsum-based topping compounds have been poured over the subflooring system and between

the screeds, a large amount of moisture is introduced to the screeds/sleepers from this process. Check the moisture content of the screeds/sleepers as well as the lightweight concrete or gypsum-based topping as directed by the applicable manufacturer. Once the moisture levels are within acceptable range, use of a Class II vapor retarder may be used.

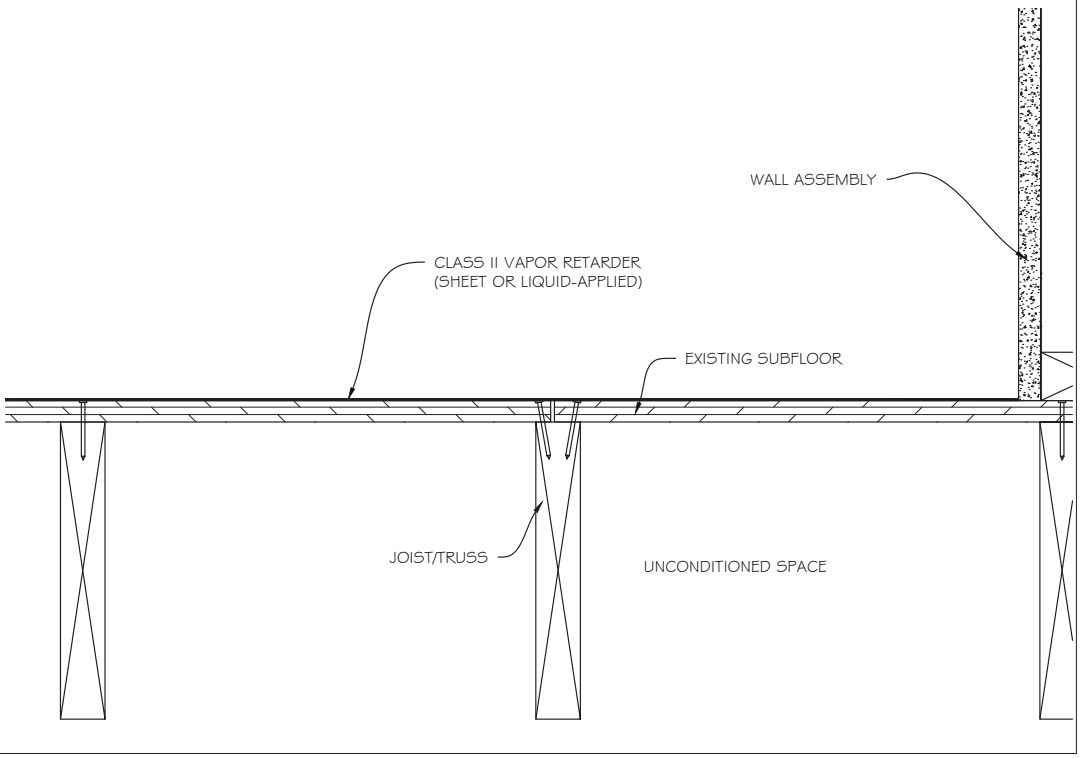
C. Radiant Heat Systems
   1. Due to the variety in the types of substrates of which radiant heating systems may be a part, follow the methods as listed in the applicable subfloor section.

D. Existing Floors
   1. When installing over an existing floor covering such as ceramic, terrazzo, slate, and marble that have been installed over concrete, a class II vapor retarder may be necessary.
   2. When installing over an existing wood floor, follow the methods as listed in the Vapor Retarders over Wood Subfloors section prior to installing any new wood floor.
   3. When installing over an existing floor covering such as vinyl, linoleum, adhered cork, or resilient flooring, no vapor retarder may be necessary.

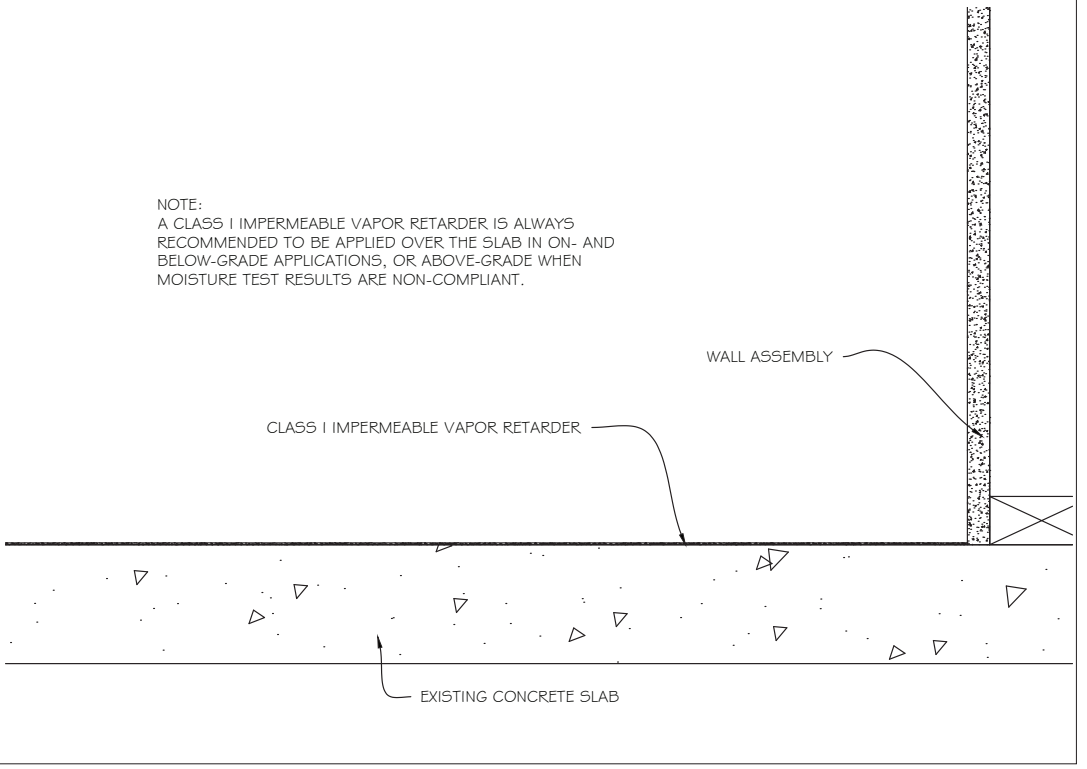
VAPOR RETARDER ON UNDERSIDE OF JOISTS/NO VAPOR RETARDER ON SUBFLOOR



VAPOR RETARDER OVER WOOD SUBFLOOR



VAPOR RETARDER OVER CONCRETE



UNDERLAYMENTS: Sound Control/Acoustical

Sound Control/Acoustical Underlayment: An underlayment material commonly used below wood flooring designed to control sound transmitted from or through the floor/ceiling assemblies.

PART I
Sound Ratings

A. Sound Ratings: In North America, there are two primary ratings used for sound control. They are Impact Insulation Class (IIC) and Sound Transmission Class (STC).

1. **IIC**, which stands for Impact Insulation Class, is a statistical measurement of the transmission of impact sound energy through a floor/ceiling assembly system (such as footsteps, dropped articles, or furniture moving across the floor). The larger the number, the more sound attenuation you have. The scale, like the decibel scale for sound, is logarithmic. IIC is measured and stated in accordance with ASTM E989 & C634, and is tested via ASTM E492.

   a. Delta (Δ) IIC is derived by subtracting the IIC of the nominal 6" bare concrete from the IIC of the various tested assemblies. The higher the Delta IIC, the higher the performance level. Delta IIC is derived from ASTM E2179, the Standard Test Method for laboratory measurement of the effectiveness of floor coverings in reducing impact sound transmission through concrete floors.

   b. FIIC, Field Impact Insulation Class, refers to testing procedures conducted in the field following ASTM E1007 and E989. The FIIC test is conducted by setting up testing equipment in the field where sound is not as controllable.

   c. AIIC, Apparent Impact Insulation Class, refers to testing procedures conducted in the field following ASTM E1007. For these metrics, sound power from associated support structures are attributed to the floor-ceiling assembly. Because these are measures of the apparent performance of the nominally separating floor-ceiling, the receiving room shall be the space directly under the tapping machine.

2. **STC**, which stands for Sound Transmission Class, is a rating of how well a building partition attenuates airborne sound (such as voices, radio, or television) in the context of multi-family facilities. STC is measured and stated in accordance with ASTM C634, and tested via ASTM E90, E336, and E596. STC values are influenced by the solid mass of the structure, but are also dependent on isolation and resilience within the structure.

   a. FSTC, Field Sound Transmission Class, refers to testing procedures conducted in the field following ASTM E1007 and E989. The FSTC test is conducted by setting up testing equipment in the field where sound is not as controllable.

B. It is important to understand what these ratings mean as they relate to flooring selection and the installation method. A number of factors contribute to a room's sound insulating ability:
   1. Floor/ceiling/wall construction and room size and shape.
   2. Interior décor, such as wall hangings and curtains, and finishes and furnishings such as chairs, sofas, tables, and rugs.
   3. Choice of floor covering material.
   4. Use of a flooring underlayment.

C. The cumulative effect of all these components is what provides the final sound characteristics of the space. No single component can fulfill the requirements for building requirements, which consider the effects of the sum of these components.

PART II
Acoustical Products and Systems

A. Acoustical underlayments are especially important when specifying and installing wood floors for multi-level structures like apartment buildings, condominiums, or within commercial facilities.

B. The use of acoustical underlayments for wood flooring is important for impact sound (IIC rating) such as footfalls, objects dropped on the floor, etc. The type of sound control system used will be dependent on a number of variables, including the type of flooring used, type of substrate, concrete thickness, ceiling suspension, framing structure, and the entire floor/ceiling assembly.

C. There are a wide variety of materials that are marketed for acoustical properties. Some are systems, and others are specific materials. Noise transfer from floor to ceiling is dependent upon the entire floor/ceiling assembly.

D. Install the manufacturer-recommended perimeter isolation barrier vertically around all perimeter and vertical obstructions on the entire floor. The perimeter isolation strip must be installed prior to laying the field.

E. Acoustical underlayment materials may be floated, adhered to the substrate, embedded within the substrate system, or installed below a floated subfloor system.

F. Acoustical underlayment materials may include cork, recycled rubber or cork/rubber blends, foam pads, recycled cellulose fiber materials, and dimpled or peel-and-stick membranes.

G. Adhered underlayment manufacturers may require the underlayment to be rolled after it has been installed. Check with the underlayment manufacturer for when, and what type of roller to use.

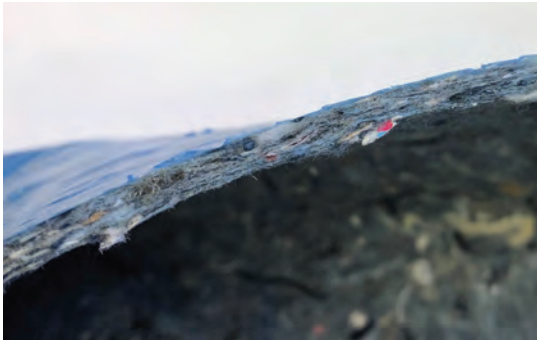
H. For floating floor installations, any underlayment materials used below a wood floor should have a published compression resistance and density that meets all minimum requirements of the flooring being installed over it. Check with the flooring manufacturer for minimum compression resistance and density requirements.

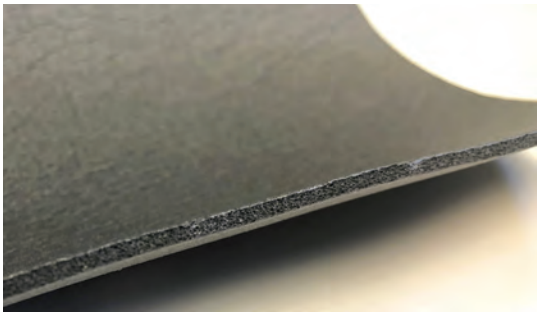
I. Some wood flooring adhesives also have acoustical reducing properties. Check with the adhesive manufacturer for proper application methods and acoustical qualities.

J. Cork, recycled rubber, or cork/rubber-blend underlayment:

1. Cork, recycled rubber, or cork/rubber blends normally come in rolls or panels.
2. Install the perimeter isolation strips prior to laying any underlayment material.
3. Install the underlayment against the perimeter isolation strips.
4. The underlayment should cover the entire flooring area without gaps and be securely bonded with all adjoining seams butted together.
5. For floating wood floor installations, the underlayment may be loose-laid or adhered to the substrate as directed by the manufacturer. For glue-down wood flooring installations, the underlayment must be adhered to the substrates. Never nail through cork, recycled rubber, or cork/rubber blended underlayment.
6. Water-based contact adhesives or wood flooring adhesives are most often recommended for glue down installation of tiles or planks. Follow the underlayment manufacturer's instructions on proper installation methods and what adhesive to use.
7. For glue-down wood floor over cork, recycled rubber, or cork/rubber blends, choose a wood flooring adhesive compatible with the underlayment. Follow the specific adhesive manufacturer instructions on application process.
8. For nail-down wood floor installation, the underlayment must be overlaid with the floated subfloor system, as detailed in the Wood Subfloors over Concrete chapter. Be sure not to allow the flooring fastener to penetrate the underlayment.

K. Underlayment Pads (foam pads, recycled cellulose fiber materials, and dimpled or peel-and-stick membranes):





1. Install the underlayment material with the proper side facing down. Follow the underlayment manufacturer's instructions on installation method.
2. The underlayment materials are normally laid with seams butted together. Seal all seams of the underlayment material using a manufacturer-approved tape (impermeable moisture control tape to seal the seams, such as a plastic or foil tape). Many underlayments include double-sided tape to ensure the seams are adequately adhered.
3. For floating wood floor installations, underlayment pads may be loose-laid or adhered to the substrate as directed by the manufacturer. Never nail through underlayment pads.
4. Unless otherwise dictated by the underlayment manufacturer, extend the underlayment a few inches up the wall. Trim excess after the floor has been installed. Note: some products require perimeter isolation strips to be installed prior to underlayment material.
5. For adhered underlayment pads, only use an adhesive as recommended by the underlayment manufacturer that is compatible with the properly prepared substrate.
6. For peel-and-stick underlayments, refer to the wood flooring manufacturer for specific installation instructions.
7. Do not install acoustical underlayment below an engineered wood floor that already has an underlayment attached to it, unless otherwise recommended by the flooring manufacturer.
8. When underlayment material does not provide moisture control, and a vapor retarder is necessary for the installation method, use a Class II vapor retarder below the acoustical underlayment. (Refer to the Underlayments: Moisture Control chapter for more detail.)
9. For adhered underlayment pads, roll the entire floor if required by the adhesive and underlayment manufactures.

PART III
Specification

A. Builders, architects, and specifiers often use lab and/or field tests when specifying floor/ceiling assemblies. Lab tests are a more-accurate model for predicting attenuation performance in a range of different construction types. Field tests are accurate only for the site where the tests were performed. Determine what systems have been specified by obtaining a copy of the Covenants, Conditions, and Restrictions (CC&Rs) for the flooring project prior to bidding on the work.

B. The protocol for specifying a flooring system is to first determine the IIC, Delta IIC, or STC requirements, then work with the builder, architect, and specifier to identify a flooring and underlayment combination that aligns with the facility requirements. Follow the flooring and underlayment manufacturer installation instructions and ensure the product used is a part of an entire sound control system.

C. When installing wood flooring in multi-family dwellings, in most jurisdictions, there are minimum IIC and STC values that the floor/ceiling assembly must achieve. It is necessary to take into consideration the building code standards including Uniform Building Code (ICC/UBC) or International Building Code (IBC), both of which call for minimum 50IIC (45IIC if field tested) and 50STC (45STC if field tested) values.

D. In addition to building code standards, many Homeowners Associations have their own minimum standards written into their CC&Rs, which will supersede, and are often more-stringent than, the minimum building code requirements.

E. Specification of the proper sound control system with any floor covering change-out/remodel in existing buildings is just as vital in the design-build stages of the project.

PART IV
Installation Methods

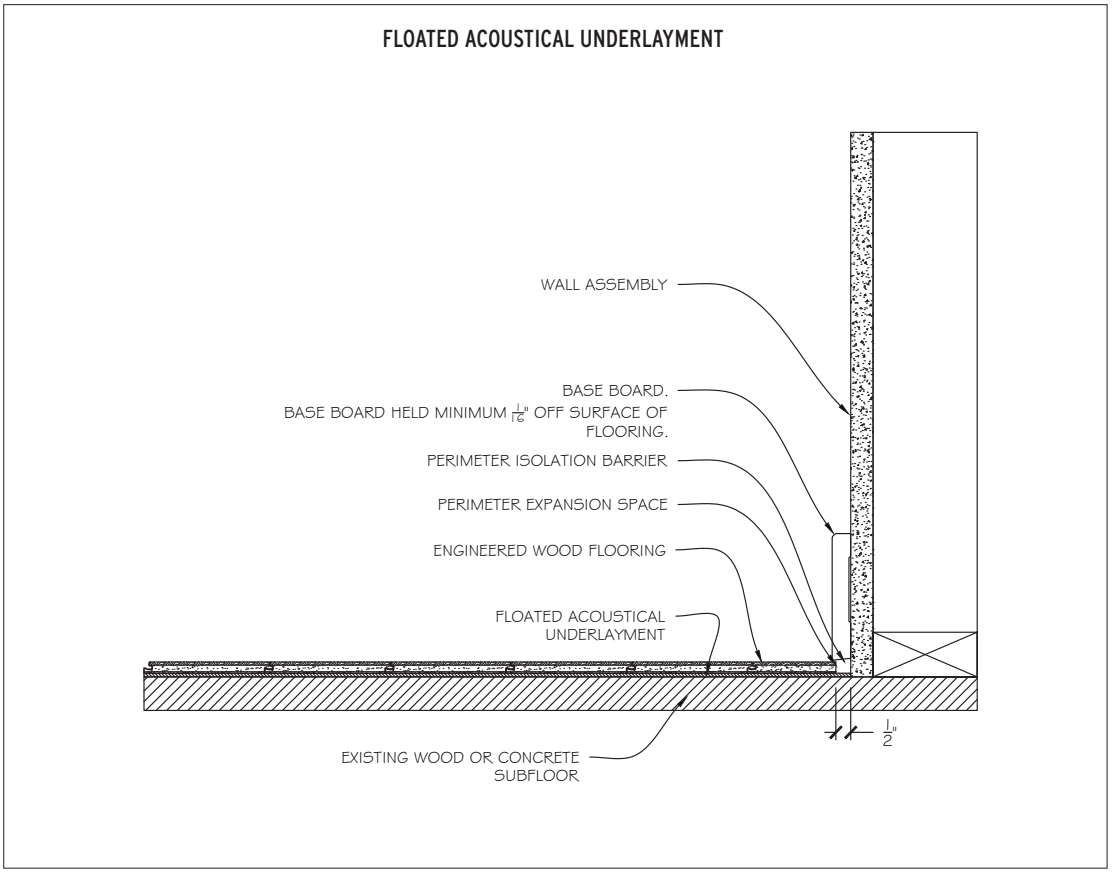
A. Installation methods may include floating, glue-down, or nail-down, but each method has its own unique variables to maintain the control of sound.

B. Each acoustical underlayment system is designed to create an isolation barrier between the installed flooring system and what lies underneath. During installation, avoid hard surface transference points. The floor should not come in direct contact with any vertical obstruction. Some HOAs may have written in their CC&Rs to use acoustical foam in the expansion space as well as acoustical sealant to meet their standard.

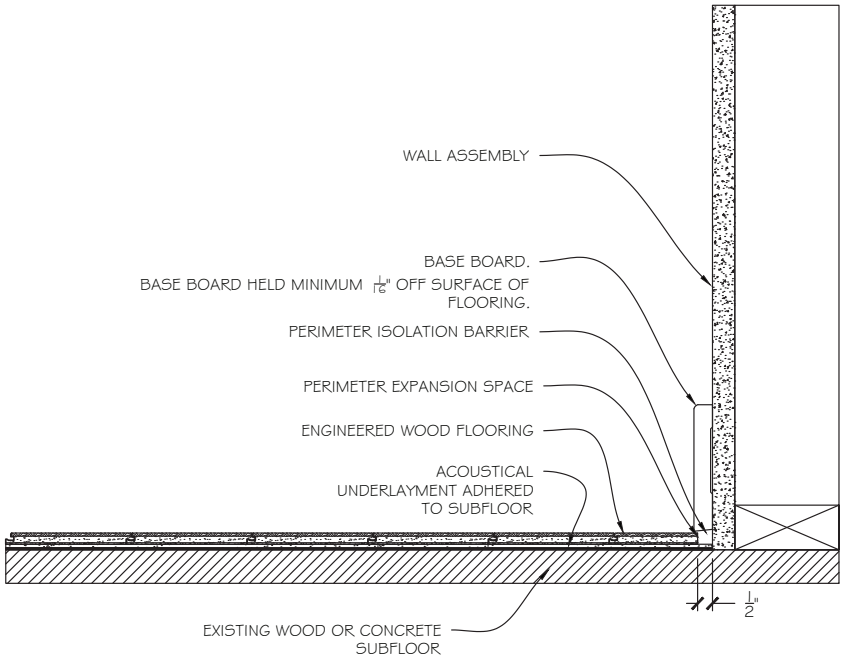
C. The moulding should not come into direct contact with the flooring. A small gap should be left between the moulding and the floor. The moulding fasteners should be driven into the wall, and not into the flooring.

D. Unless otherwise directed by the flooring manufacturer, never nail through an acoustical underlayment system. Nailing through an acoustical underlayment is not recommended for the following reasons:

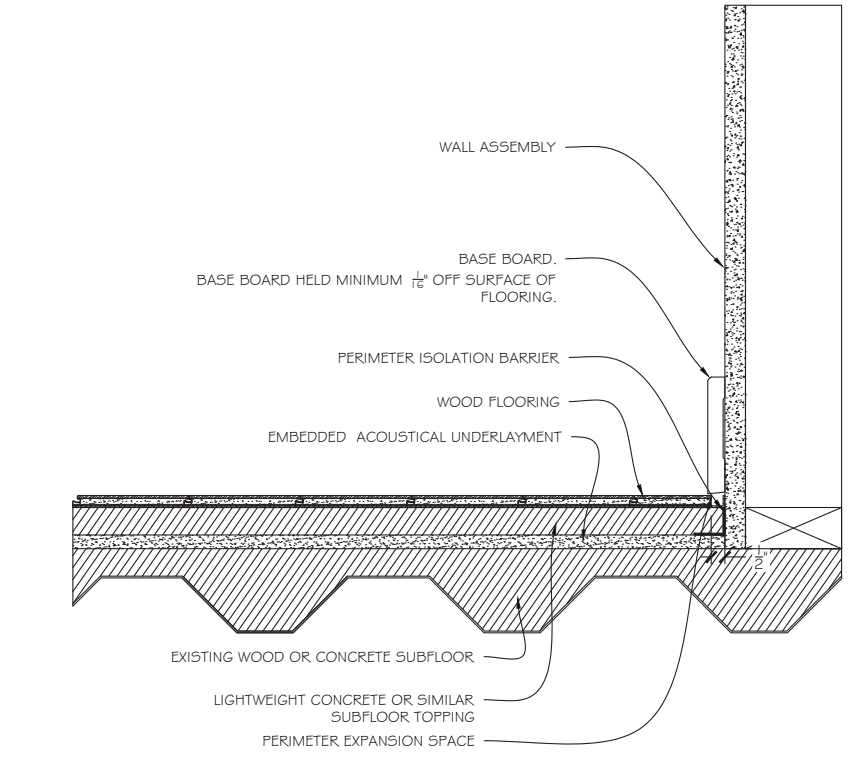
1. Doing so will compromise the specified IIC or STC ratings.
2. Most of these underlayment materials are not designed to hold a fastener. The fastener withdrawal resistance becomes greatly diminished and will likely result in undesirable noises, movement, or a loosely installed flooring system. The thickness of the underlayments also minimizes the actual subfloor-fastener penetration.
3. The density of many of these underlayments may allow them to compress when a fastener is driven through, driving the flooring tight to the substrate. This can force the flooring out of a flat plane, and may result in vertical movement and noise within the flooring system. This also creates pivot-points/anchors within the flooring system.



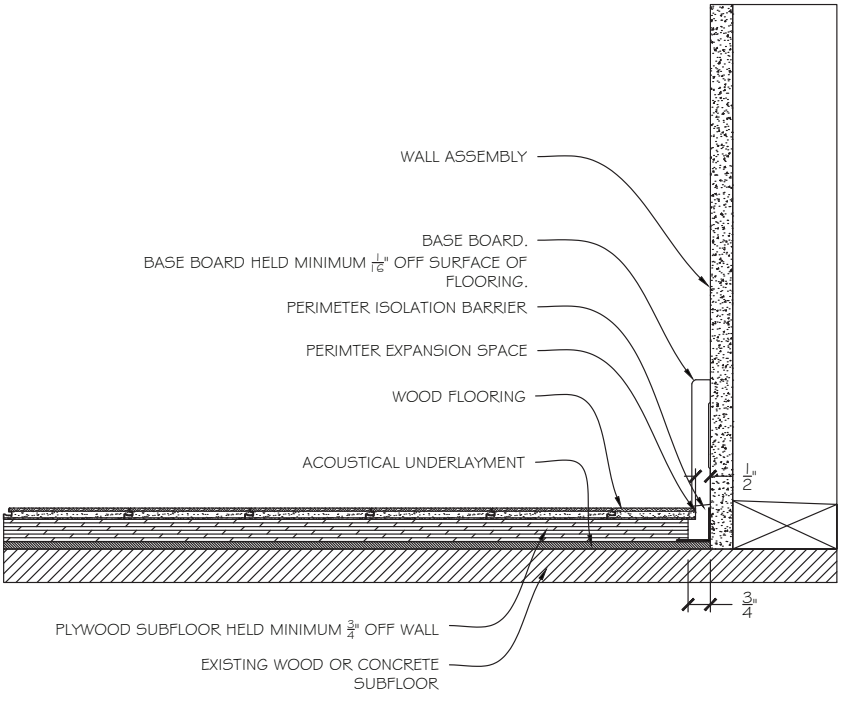
ADHERED ACOUSTICAL UNDERLAYMENT



EMBEDDED WITHIN SUBSTRATE



FLOATED SUBFLOOR OVER SOUND CONTROL SYSTEM



WOOD FLOORING ADHESIVE USED AS ACOUSTICAL MEMBRANE