acoustics 101

The following is a brief tutorial that describes the use of a flooring underlayment as an acoustic barrier.
why use a floor underlayment?

IT’S WHAT’S UNDERNEATH THAT COUNTS® - BENEFITS OF AN ACOUSTIC FLOOR UNDERLAYMENT

1. Improves acoustic performance
   a. Through the floor impact noise.
   b. Through the floor airborne noise.
   c. Reflective walking noise within the room.

2. Helps control MVTR.

3. Adds R value

4. Proper compression helps protect tongue and grooves.

5. Helps eliminate minor subfloor imperfections.
understanding acoustics

WHAT’S THE GOAL?


2. Controlling noise WITHIN spaces.

6/3/2015
understanding impact noise
understanding IIC

ACOUSTICS 101. IMPACT INSULATION CLASS (IIC) DEFINED

CODES & TESTING : IMPACT INSULATION CLASS (IIC) CODE: IIC rates a floor/ceiling assembly’s ability to block impact sound. This is recognized as an industry standard.

GENERAL INFORMATION: The Uniform Building Code (UBC) contains requirements for sound isolation for dwelling units in Group-R occupancies (including hotels, motels, apartments, condominiums, monasteries and convents).

UBC requirements for floor/ceiling assemblies: IIC ratings of 50 (if tested in a laboratory) or 45 (if tested in the field*).

* The field test evaluates the dwelling’s actual construction and includes all sound paths.

DEFINITIONS:
• Impact Insulation Class (sometimes referred to as Impact Isolation Class) measures a floor/ceiling assembly’s resistance to the transmission of structure-borne or impact noise.

IIC STRENGTH: Helps to rate structure-borne noise such as footfall, a chair dragging on the floor, or other realistic sounds in a single number.

The tapping machine frequently used for this test is not designed to simulate any one type of impact, such as a male or female footsteps, nor to simulate the weight of a human walker. Thus the subjectively annoying creak or boom generated by human footsteps on a limber floor assembly may not be adequately evaluated by this method (American Society for Testing and Materials – ASTM, E 1007, 5.2).

Recommended Isolation Level
An IIC rating of 50 will satisfy the building code requirements. As with STC, it is typically argued that luxury accommodations require a more stringent design goal. Bare in mind, some floor assemblies rated as high as IIC 70 could still transfer noticeable footfall noise.
understanding IIC

ACOUSTICS 101. IMPACT INSULATION CLASS (IIC) - TESTING TOOLS

Tapping Machine. Used in SENDING ROOM.

Microphone. Used in RECEIVING ROOM.
understanding IIC

ACOUSTICS 101. IMPACT INSULATION CLASS (IIC) TEST SET-UP

Acoustic labs conduct the IIC test using a tapping machine with steel faced hammers. These hammers strike a test floor material generating sounds between 125 to 4,000 Hz. The impact creates vibrations that travel through the floor into the receiving side (the room below). The engineer plots the results of each tap on a graph, compares the results to the reference assembly, and determines the IIC rating from comparing these two tests. A higher number shows better performance. The IIC rating does not account for any squeaking or rattling caused by loose wood frame construction. Nor does it account for low frequency footfall noise or structural deflection.

The IIC ratings for basic concrete sub-floor with no resilient underlayment is around 28 to 35 IIC. The IIC ratings for basic wood structure with no resilient underlayment is around 40 to 45 IIC. Without the addition of sound isolation products, the IIC rating of basic wood structures will rate better than concrete structures because they are naturally more resilient.

An IIC rating of 50 and above is most common in building code and HOA requirements.
understanding airborne noise

STC
understanding STC

ACOUSTICS 101. SOUND TRANSMISSION CLASS (STC)

Controlling noise BETWEEN spaces.

CODES & TESTING: SOUND TRANSMISSION CLASS (STC). STC rates a partition's or material's ability to block airborne sound. This is recognized as an industry standard.

GENERAL INFORMATION: The Uniform Building Code (UBC) contains requirements for sound isolation for dwelling units in Group-R occupancies (including hotels, motels, apartments, condominiums, monasteries and convents).

UBC requirements for floor/ceiling assemblies: STC ratings of 50 (if tested in a laboratory) or 45 (if tested in the field*).

*The field test evaluates the dwelling’s actual construction and includes all sound paths.

DEFINITIONS:
Sound Transmission Class rates a partition's resistance to airborne sound transfer at the speech frequencies (125-4000 Hz). The higher the number, the better the isolation.

STC Strength: Classifies an assembly's resistance to airborne sound transmission in a single number.

RECOMMENDED ISOLATION LEVEL:
An assembly rated at STC 50 will satisfy the building code requirement, however, residents could still be subject to awareness, if not understanding, of loud speech. It is typically argued that luxury accommodations require a more stringent design goal (as much as 10dB better – STC 60). Regardless of what STC is selected, all air-gaps and penetrations must be carefully controlled and sealed. Even a small air-gap can degrade the isolation integrity of an assembly.
understanding STC

ACOUSTICS 101. SOUND TRANSMISSION CLASS (STC) - TESTING TOOLS

Speaker. Used in SENDING ROOM.

Microphone. Used in RECEIVING ROOM
STC stands for sound transmission class. This is the most common rating used in North America for determining airborne sound transmission loss between 125 and 4,000 Hz. This range covers the majority of common noises we hear including speech, television, music, dogs barking, and other similar annoyances. A higher STC rating often shows improved performance. However, the rating is essentially an average over the 16 frequency points tested. Because of this, a product can perform exceptionally well in one range, poorly in another, and still end up with a better STC rating than a competing product that may have performed better in a frequency range more relevant to your project requirements. This is a pretty common occurrence that should not be ignored when comparing products. Sort through the misleading ratings by gaining access to actual sound test data showing the STC contour line on the transmission loss graph. The performance in relation to the STC contour line will reveal the consistency of the product over the most common frequencies.

The STC rating for a basic wood structure floor/ceiling is 40-43. The STC rating for a six inch concrete sub-floor is 52-55.

A good level of isolation for walls and ceilings is STC 50 plus. A high level of isolation for walls is STC 60 plus with ceilings at STC 50 plus.
understanding delta testing

ΔIIC
The ΔIIC rating shows what the product adds to the assembly in terms of isolating impact footfall noise. The Delta IIC test starts by testing a full assembly, typically six to eight inches of concrete, with nothing above or below the concrete. Then an underlayment installs directly to the concrete, and the same test repeats. **The Delta IIC rating is the performance gain between the first and second test. A higher number shows better performance.**

The Delta IIC rating is the best rating to consider when comparing the performance of different types of underlayment. It keeps the manufacturers from promoting misleading results obtained by using materials or methods of isolation that the average assembly does not use. Misleading results are most often found with claims of 60 IIC or above using materials less than 1/2” thick. They achieve their astronomical rating with decoupled ceilings and considerable additional mass, but will claim their thin underlayment is what achieved that IIC rating. If the IIC rating is unreasonably high, then ask to see a Delta IIC rating. If they cannot provide a Delta IIC rating, then ignore the advertised ratings.
understanding reflective walking noise

RWS
Walking sound is understood as the noise that is heard when the laminate floor covering inside the room itself is used (e.g. when walking over it, playing on it, etc.).

Currently there is no North America Standard for testing this. Currently on the basis of EN 16205 especially for laminate floor coverings a test method is developed that can reflect the "perceived loudness" of a laminate floor covering by the RWS-value. An appendix or a part 2 of the standard is planned describing the evaluation of the perceived loudness of a laminate floor covering.

The most commonly accepted manner to demonstrate RWS is a side by side demonstration using a common subfloor material.
understanding RWS

ACOUSTICS 101. REFLECTED WALKING SOUND (RWS) - TESTING TOOLS

Tapping Machine. Used in SENDING ROOM.

Microphone. Used in SENDING ROOM.
understanding RWS

ACOUSTICS 101. REFLECTED WALKING SOUND (RWS) TEST SET-UP

Acoustic labs conduct the IIC test using a tapping machine with steel faced hammers. These hammers strike a test floor material generating sounds between 125 to 4,000 Hz. The impact creates vibrations that travel within the sending room. The engineer plots the results of each tap on a graph, compares the results to the reference assembly, and determines the RWS rating from comparing these two tests. A LOWER number shows better performance. The RWS rating does not account for any squeaking or rattling caused by loose wood frame construction. Nor does it account for low frequency footfall noise or structural deflection.

Controlling noise within spaces.
suggested reference sources
There are numerous resources available on-line to expand your knowledge of acoustic testing. Following are some of the more credible sources for your review.

1. www.acoustics.com
2. www.isostore.com
understanding acoustic test reporting
understanding test reporting

ACOUSTICS 101. IMPACT INSULATION CLASS (IIC) TEST REPORT – REFER TO IPAD

Defines test facility
Defines lab accreditation
Defines internal test report number
Defines company information
Defines ASTM test method
Defines test assembly
Defines test no, date, sign-offs
understanding test reporting

ACOUSTICS 101. IMPACT INSULATION CLASS (IIC) TEST REPORT


The assembly limits of such tapping machine location meet the precise requirements of section 11.3 of ASTM E 492-66.

Specimen Description: Floor-ceiling assembly. 4 inch (102mm) concrete slab with suspended gypsum ceiling covered with, according to client; wood laminate flooring over Floor Muller with Advanced Cell Technology Underlayment.

The test specimen was a floor-ceiling assembly consisting of the following:
- 1 layer of T&G wood laminate flooring; 8 mm (0.31) thick, 197mm (7-3/4 in) wide panels, 45.8m (1.56 PSF).
- 1 layer of 2.0mm (0.08 in) yellow "Floor Muller with Advanced Cell Technology" from underlayment ID: DAFTELD.08.06.920, 0.098 kgs/m² (0.02 PSF).
- 152mm (6 in) thick reinforced concrete slab: 166 kgs/m² (35.0 PSF).
- Drywall grid suspension system consisting of 15.8mm (5/8 in) type X gypsum board 11.2 kgs/m² (0.3 PSF) attached with 24.6mm (1-1/8 in) screws, 368mm (14 in) o.c. to suspended grid suspension system. 307mm (12 in) plywood with 89mm (3-1/2 in) lay-in fiberglass insulation 0.78 kgs/m² (0.16 PSF).

The overall weight of the test assembly is 317.8 kgs/m² (79.64 PSF) nominal.

The perimeter of the floor assembly was sealed with rubber gasketing and a sand filled trough. The test assembly is acoustically isolated from the receiving room. Board joints were taped and the ceiling perimeter was sealed with acoustical caulk.

Specimen size: 3458mm x 4877mm (12 ft x 16 ft).

Test samples were submitted by client and tested as received.

Conditioning: Assembly was stored under room conditions prior to testing.

Test Results: The results of the tests are given on pages 3 and 4.
ACOUSTICS 101. IMPACT INSULATION CLASS (IIC) TEST REPORT

Normalized impact sound pressure level

<table>
<thead>
<tr>
<th>Frequency (Hz)</th>
<th>L_n (dB)</th>
<th>L_2 (dB)</th>
<th>T (sec)</th>
<th>C (dB)</th>
<th>u.Dev (dB)</th>
<th>dL (dB)</th>
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<td>45.0</td>
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<td>150</td>
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<td>46.0</td>
<td>3.09</td>
<td>1.0</td>
<td>0.9</td>
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</tr>
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</table>

Where:
- \( L_n \) = Normalized Sound Pressure Level, dB
- \( L_2 \) = Receiving Room Level, dB
- \( T \) = Reverberation Time, seconds
- \( dL \) = Uncertainty for 95% Confidence Level

The results reported above apply to specific samples submitted for measurement. No responsibility is assumed for the performance of any other specimens.

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1865 Military Road · Buffalo, NY 14217-1138
(716)873-9750 · Fax (716)873-9753 · www.ngctestingservices.com

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Defines test results over various frequencies
understanding test reporting

ACOUSTICS 101. IMPACT INSULATION CLASS (IIC) TEST REPORT

Defines test result in dB
test library

Diversified Industries maintains a library of test results that includes many different products, test environments, and test set-ups.

For more information, please contact us by phone at 800-440-6008 or by e-mail @ sales@diversifiedindustries.com.