How to achieve simple, effective noise control in wood-framed multi-unit housing construction utilizing next generation decoupling technology*

*****HushFrame Raft Connectors w/ Vi-Bridge® silicone vibration isolation

WHAT?

HushFrame Raft Connectors: a patented, wood-based product designed to inhibit noise transmission by decoupling (separating) gypsum surface panels from the structural framing members in the walls and floor/ceiling assemblies of buildings. HushFrame Rafts are a simple and effective soundproofing solution, consisting of two plywood elements separated and secured by a Vi-Bridge® core of silicone rubber that absorbs noise vibration energy seeking to move through building construction.

WHY?

The United States has adopted the International Building Code (IBC) minimum standards for acoustical privacy in multifamily housing construction. But as evidenced by occupant complaint, HOA litigation, and common builder experience, new construction most often fails to achieve the code-mandated minimum levels of sound isolation. HushFrame addresses these issues, as empirically demonstrated by installation in a wide variety of building environments and supported by extensive certified laboratory and post-build acoustic field testing.

While noise challenges in buildings have persisted for decades, there is growing awareness in the building development industry that noise arising from neighbors is a genuine problem requiring mitigation. Building density is burgeoning, code enforcement is strengthening, tenant litigation for noise is on the rise and the housing industry is increasingly choosing to build sustainable engineered wood-framed structures that are lighter and far noisier than the robust frames of the past. Noisy floor/ceilings are the assemblies most in need of acoustic solutions since the largest volume of occupant complaints by far arise from impact noise (think people walking on the floor above you). These trends put pressure on builders to seek alternatives to legacy soundproofing methods that are proven to underperform and that will expose builders to ongoing liability.

Let us show you why past approaches have failed and how simple it can be to get on the right side of the equation. First, the basic landscape and then the special sauce.

NOISE, STC and IIC

Webster's Dictionary defines noise as 'clamor; disagreeable sound'; noise is simply unwanted sound. Sound is not complicated; it consists of waves of vibration energy. Air-borne sound waves begin as human speech, music, traffic, etc. that enter walls and floor/ceilings after colliding with their surfaces. Structure-borne sound waves begin as footsteps, banging, or dragging furniture and enter the floor/ceilings through direct mass impact. Going forward let's swap the word 'sound' for the word 'noise'. The ability of walls and floor/ceilings to resist air-borne noise from passing through them is measured in a rating known as Sound Transmission Class or STC. The ability of the floor/ceilings to resist the structure-borne noise from getting through is measured in a rating known as Impact Insulation Class or IIC. Both STC and IIC ratings are expressed as numbers; and the bigger the number, the better for fighting noise. The code mandated minimum STC performance for walls and floor/ceilings between tenants and separating tenants from mechanical and common areas is 50, as tested in an acoustic laboratory. The code mandated minimum IIC performance for floor/ceilings between tenants is also 50 as tested in an acoustic laboratory. These numbers essentially correspond to decibels (dBs), which are simply measurements of noise intensity (volume). The relationship between dB ratings of the noise that impacts your ears, and the dB ratings of the building assembly are inverted. An STC 60 rated wall assembly is good, but 60 dBs of noise getting through a wall assembly is not good. We'll bring you up to speed on this.

HOW ARE STC & IIC LABORATORY TEST VALUES DETERMINED?

For certified acoustic laboratory tests, a specified wall or floor/ceiling assembly is constructed in an opening (called an aperture) between two rooms (chambers) of roughly equal dimensions and volumes of space. For wall tests, the chambers are side by side, and for floor/ceilings the chambers are one on top of the other. Once the test assembly construction is completed in the aperture, the room on one side is designated as the 'Source Side Chamber' where the noise will be created/introduced, and the room on the other side will be designated as the 'Receive Side Chamber' where the noise that passes through the assembly is measured. For STC testing, a noise generator (essentially a big loudspeaker) creates 100 dB (decibels) of constant 'Pink Noise'. Pink noise contains a mix of all the frequencies perceptible to the human ear with a bias to heavy, low frequencies (think bass notes, drums, those most disturbing to humans). For IIC testing, a 'Tapping Machine' is placed on the floor of an assembly chamber and a series of cam driven steel hammers pound the floor assembly surface in an intensely measured rhythm. In both STC and IIC testing, computers compare the volume of noise produced in the source chambers, adjust for condition differentials between the chambers such as cubic volume, air temperature and humidity, and then record the volume of noise measured in the receive chamber. The numerical differential between the noise volume of the source chambers and the receive chambers is the STC or IIC rating of the assembly. To recap; 100 dBs pink noise in the source chamber side which measures 40 dBs in the receive chamber side, means that wall assembly achieves an STC 60. That's a good wall assembly.

THE COMPETITIVE LANDSCAPE

Single wood-stud walls and wood-truss floor/ceiling assemblies will not achieve code mandated noise reduction levels without fortification, for example a typical 2x6 wood-stud wall framed 16" on centers with R-19 batt insulation in the cavities and 5/8" gypsum panels on each side will earn an STC 36, without deducting for penetrations for electrical boxes and such. Meanwhile, there is a wide array of acoustical products on the market today representing significant variation in both effectiveness and practical application to address this shortfall. Simplistic approaches range from dense 'acoustic' cavity insulation material to surface-applied colored glue intended to sandwich two layers of gypsum panels and create resilience. These products fall short of their representations.

There are also numerous manufacturers of various gypsum panel composites, sometimes four or five layers deep that claim high noise resistance in wall installations, though not typically specified for use in ceilings due to extreme mass weight and deflection. And while a few of these products can help you barely make the basic code, these assemblies are unwieldy, very expensive, and prone to short-circuiting and flanking, which significantly degrades acoustical performance.

HOW DOES NOISE MOVE THROUGH THESE BUILDING ASSEMBLIES?

Essentially in just two ways. Firstly, air-borne noise joins structure-borne noise when it collides with the surface of the wall or floor/ceiling and the vibration enters the assembly. Once it penetrates the surface, the noise energy travels quickly through the dense materials (framing lumber, wood sheathing, gypsum panels) at a velocity of 12,000 +/- feet per second (FPS) until it exits the opposite side of the assembly and reverts to air-borne noise again, this is structure-borne transmission. Secondly, at the interior of the assembly, the noise energy exits the backside of the wood subfloor sheathing or gypsum panels into the void behind, known as the stud bay or joist bay, where it resonates (bounces around) in the open space and then enters the backside of the material covering the other side of the assembly, passes through and exits as air-borne noise again. This is known as 'Air-Spring' and this phenomenon occurs at a velocity of 1,200 +/- FPS (the speed noise moves through air) or roughly only 10% of the efficiency (speed) of the structure-borne transmission.

HOW CAN THIS NOISE MOVEMENT BE CONTROLLED?

Surprisingly easily. The air-spring is defeated by the simple installation of a soft insulation material in the stud or joist bays that prevents the noise vibration waves from bouncing around as their low-speed energy is absorbed by the soft insulation. No material is more effective at this than basic un-faced fiberglass batt insulation. Equally effective is blown-in loose fill fiberglass or cellulose that is held in place by light netting. Surprisingly, specialty insulation materials that are marketed as acoustically superior, such as dense mineral fiber, underperform basic fiberglass. The extra density creates a rigidity that provides a bridge that noise vibration can travel across, changing the equation slightly from air-spring management to structural transmission when these dense insulations are packed into stud/joist cavities. Their advertised superior acoustic performance is deceptive, based on laboratory testing where sheets of these dense materials are openly hung in the test chamber aperture and tested unencumbered by framing members and gypsum sheathing. The manufacturers market the dB loss of the raw material alone and ignore the consequence of the bridging that occurs once installed in an assembly. And under no circumstance should spray foam rigid insulation ever be introduced in an acoustic assembly.

Then, with the air-spring taken care of, most of the noise energy emanating from the structural transmission, must be dealt with through decoupling.

WHAT IS DECOUPLING AND HOW'S IT DONE?

Decoupling can be simple. Historically, build two separate parallel walls, leave a minimum 1" airgap between them, add cavity insulation and heavy gypsum panels to each side and you can effectively achieve the code mandated minimum STC rating. The cost is the extra framing lumber, labor, and the loss of valuable floor square footage. For floor/ceilings, decoupling has always been more complicated, nearly always requiring some sort of complex suspended system, and rarely seen in contemporary building outside of institutional settings. Decoupling has evolved through iterations of new product development and is now the most sophisticated and effective approach to soundproofing walls and floor/ceilings. A builder can achieve it by separating the finish assembly surface (typically gypsum board) from the structural framing members on one side of a demising assembly, thereby substantially interrupting the pathway by which noise vibration energy transits from one side to the other.

CAN YOU DESCRIBE DECOUPLING IN LAYMAN'S TERMS?

Decoupling involves the separation of the finished wall surface (usually gypsum board) from the structural framing to break the structure-borne transmission path used by the noise vibration waves to transit through the assembly. In historical building technique, the gypsum drywall or plaster/lath components were always fastened directly to the face of the studs or joists along the full length of the framing components; this is called 'Line Connection', where there is uninterrupted opportunity for noise energy to move efficiently through the framing and onto the finish wall surface. With decoupling, a builder employs the technique of 'Point Connection', where small, isolated devices (ours are called 'Raft Connectors') are attached to the framing members in a grid pattern, followed by furring strips attached to the connectors and then the wall finish (typically gypsum panels attach to the furring). Point connection limits the surface area of the framing members available for the noise vibration to cross through the assembly and concentrates the transmission to those connectors.

WHAT DECOUPLING PRODUCTS ARE AVAILABLE ON THE MARKET?

There are numerous metal decoupling connector products on the market (typically marketed as 'Clips') that work in concert with metal furring (Hat Channel) and there are HushFrame connectors, the only decoupling product that works in concert with wood furring. There are also a few metal furring products marketed for direct attachment to the framing member faces without the requirement of pairing with metal clips, namely metal hat channel furring and metal resilient channel (RC) furring.

WHAT WORKS, WHAT WORKS BEST, AND WHAT DOESN'T WORK?

Direct attachment metal furring is the least effective and RC is an unmitigated disaster in acoustic assemblies. While the point connection benefit should apply in theory, the hard attachment of the metal furring to the framing faces simply allows the noise energy to pour into the length of the furring which has a line connection to the finish gypsum panels and the vibration just moves perpendicularly. The performance of RC in ceilings is so poor (estimates are 90% failure) that most installations require it to be coupled with gypsum cement subfloor topping over resilient padding to achieve code minimum acoustics. Every acoustic field test we've seen where RC is installed in ceilings with various subfloor acoustic panel products has failed to meet IIC code minimums--thus requiring expensive mitigation and provoking tenant hostility.

The metal clips coupled with metal hat channel perform decidedly better than RC but suffer from a few basic weaknesses. First, the plastic polymers utilized in the decoupling clips are stiff and have a short effective lifespan of 15-20 years before they begin to degrade. Next, the physical requirement to manually squeeze the metal hat channel to nest it in the clips is extremely challenging for the installers--often resulting in carpal tunnel injuries among other complaints. And the most significant weakness acoustically is that with metal furring channel installations, all electrical devices, light fixture and cans, motorized fans, HVAC ducts and registers, etc. must be attached directly to the framing members and not the decoupled metal furring. This attachment handicap allows short-circuiting and flanking paths for noise directly from the framing surfaces to the gypsum panel surfaces. This weakness is only memorialized in acoustic field testing of as-built environments. The product manufacturers only publish their ideal test results from acoustic laboratory testing of assemblies without these common mechanical penetrations, that don't reflect the performance reality exposed by field testing.

HushFrame outperforms all these products and assembly composition strategies. We proactively field test installations and we openly share the results with our customers. **Field testing is critical because it measures real-world contractor-installed and subsequent trades-impacted acoustical performance of an assembly vs. the acoustic performance of lean, ideal assembly construction produced by engineers in the immaculate environment of a testing laboratory.**

HUSHFRAME IS THE NEXT GENERATION SOLUTION FOR NOISE

The HushFrame raft connectors are the next generation solution. They are manufactured from wood, typically installed in wood-framed buildings, and utilize wood furring for the gypsum panel attachment. They support sustainable and carpenter-friendly construction. Wood furring accepts the direct attachment of all the ancillary devices: electrical, mechanical, HVAC, etc.--thereby eliminating the short-circuiting and flanking paths that are the Achilles' heel of metal-based products. HushFrame is the only decoupling product that works with wood furring and owns the proprietary UL Design M565: the only one-hour fire resistance rated wood-framed floor/ceiling assembly that allows wood furring in the construction. M565 is also the least restrictive UL design--requiring nothing more than a 3/4” plywood subfloor to achieve the rating so any finish floor is permissible.

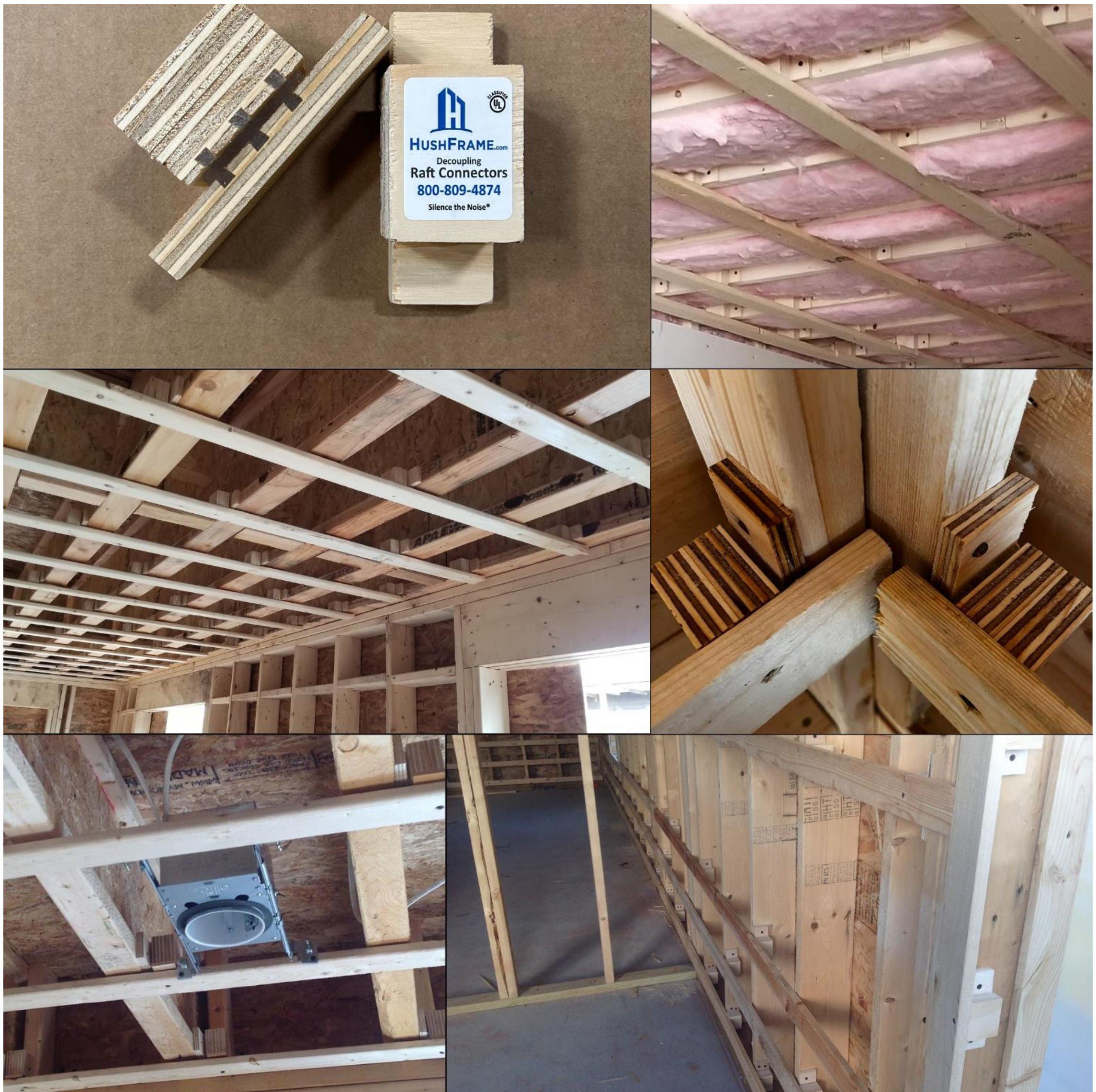
The Vi-Bridge® silicone cores of the HushFrame rafts not only decouple the assemblies but the Shore A durometer 25 silicone absorbs and eliminates vibration waves. HushFrame is particularly effective against low frequency vibration that the human ear finds disturbing and most difficult to control. Silicone is unaffected by atmospheric and chemical pollution and has a life span that will match the building.

HushFrame rafts are so effective at killing noise that a HushFrame floor/ceiling assembly with nailed-down hardwood over a 3/4” plywood subfloor outperforms an RC floor/ceiling assembly with 3/4” plywood subfloor, resilient padding, 3/4" gypsum concrete, more resilient padding, and engineered wood flooring, by 7 STC points and 9 IIC points. The HushFrame noise defeating components cost a fraction of the RC/gypcrete assembly noise components cost and deliver a floor/ceiling that is literally half as noisy - twice as quiet.

THE CONCLUSIONS

Legacy noise control products are inferior to next-generation HushFrame. Dense cavity insulations may outperform in thermal characteristics but underperform acoustically. All panel products, and composite assemblies that attach directly to stud or joist faces are defeated acoustically by the short-circuiting that results from the constellation of fasteners that penetrate and secure them to the framing members. Metal furring offers minimal acoustic relief and overwhelmingly results in code compliance failure. Metal decoupling clips suffer from their reliance on metal furring and their inability to adjust to wood framing anomalies, such as misaligned studs and joists.

HushFrame will install quickly, easily, readily adjust for assembly quirks, defeat the short-circuiting and flanking conundrum of metal furring, and acoustically outperform all other decoupling strategies for lower cost. Contact us at <HushFrame.com> for more information and specific testing data and installation guidance.



HUSHFRAME RAFT® CONNECTORS

SILENCE THE NOISE®