White Paper Series

Cost-Benefit Analysis of Using Resilient Channels vs. Viscoelastic Polymer Technology in a Hotel Complex

Abstract

Resilient channels were developed by USG in the 1960's as a method of improving sound isolation between rooms. Considerable field experience has produced estimated failure rates between 60-90% known to be caused by any one of 12 issues which arise during or post-construction. Failure results in the wall (or ceiling) assembly with an STC rating as if the RC channel was never installed, i.e. 34-38 typical range. This has been a continuing problem with this older technology. New technologies using viscoelastic constrained layer panels have been introduced to address these high failure rates. These new panels cannot fail in any of the known ways. A risk adjusted cost-benefit analysis on a hotel complex reveals that an initial incremental investment of 0.9% of the cost of building a hotel room reduces the field failure rate from over 60% to near 0%, guarantees a tested STC and produces a payback in 10 days.

Hotel's Business Issue

The hotel is 4-star in a major metro region. The baseline was a simple construction method typical in hotel construction: single layer of Type X 5/8" drywall, on 3 ½" metal stud 24" O.C., with R-13 fiberglass batt. That assembly has a well-known STC rating of 38. The hotel determined that it needed a guaranteed STC 54 for the upscale market. The issue was how to achieve a guaranteed level of acceptable sound isolation with the most cost-effective value proposition.

The marketability of this new luxury business property depended heavily on customer satisfaction. Noise was one of the critical criteria in the customer rating equation. The hotel management company routinely experienced customers demanding to be moved from a noisy room to a quiet one; or demanding a refund. The hotel did not know the "underwater" effect of customers simply refusing to come back; and even more damaging, of giving unfavorable recommendations to friends, colleagues and professional travel agents.

A favorable reputation of the hotel property is a reflection of its brand. This hotel is part of a globally-recognized management company which fiercely defends its brand, especially in newer upscale hotels. Similarly, a favorable reputation would reflect well on all involved – the architect, the acoustical consultant, and the general contractor.

Two Alternative Methods of Achieving STC 54

Old method – resilient channels

This method has been used since USG introduced the RC-1 resilient channel in 1968. The theoretical advantage of resilient channels is a low-cost method of achieving a high degree of sound isolation in simple stud construction otherwise associated with double-wall construction. Tests performed in controlled lab situations have produced results that show STC ratings between 50-55 with steel studs and resilient channel installed properly.

However, practical field experience during the last 35 years reveals that the actual long-term performance in the field is poor. Failure rate estimates range between 60-90%. A failure is defined as a wall that has experienced a short-circuit such that the resulting wall assembly produces STC results as if a resilient channel was not used.

Field investigations[1] over the last three decades have isolated 12 causes of failures.

Group A failures are caused during construction and are largely the result of minor worker mistakes. This is understandable given the fact that most drywall hangers and carpenters, field supervisors and even architects and building inspectors rarely deal with RC channels. These mistakes are easy to commit without immediate evidence. Acoustical consultants estimate that 30-50% of projects fail due to Group A issues.

Group B failures, caused after the construction phase is over (i.e. during occupancy) are even more subtle and difficult to control. Even if the construction workers had performed perfectly, field experience shows that within three years, some action has been committed that causes the RC assembly to fail, in terms of it's intended result. The effect of short circuit takes a wall or ceiling from STC 50-54 to STC 34-38. This has been measured and proven for over 30 years in the field by forensic acoustical engineers, often called in to find out what went wrong. Acoustical consultants estimate that 20-40% of projects fail due to Group B issues.

Group A: Short-circuit Caused During Construction

1) The original RC-1 used in most certified lab tests no longer exists as USG stopped making the product in 1985. As there is no standard for RC channel fabrication, the various resilient channels available vary greatly in their resilient (stiffness) characteristics. Using currently available RC channels that are often too stiff results in reduced STC values and produces poor sound insulation.

2) The RC channels might be placed too close together. If this happens, the composite stiffness of the wall will be too high and result in reduced sound insulation.

3) If the RC channel is accidentally installed upside down, the weight of the drywall can push the channel into the studs (instead of pulling it way from the studs when installed properly) thus causing a short-circuit in the wall and resulting in poor sound insulation.

4) If an RC channel extends too far and touches any adjoining wall, it will cause a short circuit in the wall and result in poor sound insulation.

5) If a screw is placed incorrectly while the drywall is being attached to the resilient channel and is accidentally screwed into a stud or even touches a stud at any point, it will short-circuit the wall and result in poor sound insulation.

6) If there is an insufficient gap between the wall with the resilient channel and the adjacent wall such that the drywall attached to the RC channel touches the drywall on the adjoining wall, the wall will be short circuited and result in poor sound insulation.

7) If the drywall is not installed properly or if the contractor adds drywall that is beyond spec (e.g. a contractor adding a layer of Type X to meet fire code or using ¾" where 5/8" is spec'd), the resulting structure can sag, and the weight of the drywall on the resilient channel can cause the wall to touch the floor thus causing a short-circuit in the wall and resulting in poor sound insulation.

8) If the electrical boxes are attached to the stud and to the wall, this will cause a short-circuit in the wall and result in poor sound insulation. This error is common and easy to

[1] Acoustical engineering consultants are frequently called in to provide expert testimony in issues that result in mediation, arbitration and litigation. The failure rates and causes of failure have been accumulated over a growing body of such field investigations using STC measurement instrumentation. Often, the acoustical engineer has to invade the wall to find the culprit. Litigation on noise issues is becoming more frequent, and the cost of litigation and settlements are rising rapidly.

do with the face plate, which must also be isolated or by not cutting enough of the drywall away from around the junction box.

9) If the gaps around the junctions at the wall are sealed with standard caulk that hardens over time (instead of resilient acoustic non-hardening caulk), this will cause a short-circuit in the wall and result in poor sound insulation.

10) If the ceiling is resilient too, the walls and the ceiling can not touch each other. To achieve this, it is recommended the walls are put up first and then the ceiling. This is counter to standard drywall installation practice and is met with resistance in the field.

Group B: Short-circuit Caused After Construction by Occupant

11) If during the life of the property, the owner or a tenant install materials to the wall, thereby destroying the STC ratings. A survey of hotels revealed the following list of products that are routinely attached to the walls for various reasons, including anti-theft and seismic restraint: bed head-board, writing desks, open shelving system, closet shelving, refrigerator, safe, sconces, mirrors, paintings, bathroom shelving, television wall stands, decorative wall hanging, crown molding, baseboard, wainscoting. For rigidity and security, these products are attached to the studs by screws which invariably causes a short-circuit and significantly reduces the STC rating of the wall. Similarly, if RC channels are used in ceiling construction, any lighting (including track lights and ceiling fans) introduced post-construction could significantly reduce the ceiling's STC value. Also, any retrofit for new communication technology, such as LAN, CATV, DBS, media router etc. that requires a junction box to be attached to the wall can significantly reduce the wall's STC value. This is particularly risky because the location of the studs and RC channels is hidden and extremely difficult to find post construction. Either the wall or ceiling has to be left alone for the life of the property or significant post-construction risk occurs.

12) If the owner or hotel guest move heavy furniture (e.g. bed, desk) against the wall with force, it can cause the resilient channel to touch the studs, thus causing a short-circuit in the wall and destroying the wall's STC rating.

New Approach

In recognition of these costly risks, Quiet Solution, Inc. developed a new technology based on drywall panels engineered with constrained-layer viscoelastic polymer technology. The method employs simple construction with near-zero risk during and post-construction. The concept behind this new technology was to specifically address the high failure rate shown using Resilient Channels. In doing so, the new drywall panel technology was designed to "absorb" noise and vibration within the panel. Thus the concept of "shorting-out" is moot, since the panel can easily absorb noise and vibration carried by screws, nails, studs, and other materials directly into the panel. This technology, with an initial material cost slightly higher than resilient channel, is nearly 100% reliable and uses far less labor than resilient channel construction.

The engineered QuietRock panels have been tested at NVLAP certified labs and produce STCs in 45-72 range depending on model and construction assembly used [2]. The owner incurs no risk – it is even acceptable to put in nails and screws directly into studs without causing a short-circuit. Unlike resilient channels, this new technology virtually assures continued sound isolation for years to come.

[2] See Quiet Solution, "Making Walls Quiet" and associated tests conducted at Western Electro-Acoustical Labs.

Cost-Benefit Analysis: Room-Level Model

The following model illustrates that the initial cost of a resilient channel is slightly less costly than using new engineered panels by approximately $1,473/room. For an average hotel built in the United States in 2002, this results in a cost increase of 0.9% per room in an average 3-star hotel.

However, the cost of failure during the lifecycle of the room far outweighs the initial cost. As indicated above, acoustical engineering consultants overwhelmingly believe - based on field experience – that during the first three years, some action will occur (often unknowingly) that destroys the STC value of the wall, even if it was perfectly constructed using resilient channels.

Cost of failure

When a wall outfitted with RC channels is short-circuited, the hard cost of repairing the problem can triple the cost of original installation.

The revenue and resale values related costs of a systemic failure outweigh the hard costs of repair, and swamp the differential of doing it right the first time by a wide margin.

Hard costs of repair	Acoustical or consulting engineer	$10-15,000
	Architect	$2-4,000
	General Contractor	$3-6,000
	Materials & Labor to retrofit	$3-5,000
Revenue costs of failure	Customer demanding to be moved to a quieter room	$75/occurrence
	Customer does not return to hotel	$150/occurrence
	Customer provides negative recommendations that cause others not to book at hotel resulting in persistently lower occupancy rates	unknown
Catastrophic costs	Litigation between owner, architect and builder	$50-100,000
	Inability to sell the building to next owner (or reduced price to reflect acoustic deficiency)	3-7% discount off ask price

Cost of Soundproofing with Negligible Risk vs. High Risk

The analysis below shows that the additional cost of “soundproofing” an average room, in an average hotel is $2000 to $3,500 depending on method.

Using the Quiet Solution Soundproofing System, this method will result in an installation that will remain soundproof for decades. The STC rating cannot be destroyed by construction errors, or by any subsequent actions of the owner or tenant unless the structure itself is significantly altered.

SOURCE: Ogershok & Pray, 2004 National Construction Estimator, Craftsman Books, Nov. 2003

Old Method: Resilient Channel STC= 54 (spec)

Per Room	Per	Material	Labor	Per 8 SF assembly 8	Total Room Cost 517	Note
Corner wall & junction plate	LF	$ 1.83	$ 2.31	$ 4.14	$ 267.55	Assume four walls
Steel frame	LF	$ 0.17	$ 0.58	$ 6.00	$ 387.75	3 1/2" 24" OC
Drywall	SF	$ 0.22	$ 0.56	$ 6.24	$ 403.26	Type X
Acoustical sealant	SF	$ 0.42	$ 0.56	$ 7.84	$ 506.42	QS-350
Insulation	SF	$ 0.30	$ 0.17	$ 3.76	$ 242.99	R-19
Resilient channel	LF	$ 0.17	$ 0.31	$ 3.84	$ 248.16	RC-1
Wall cost for typical hotel room with RC Channel					**$ 2,056.13**	Net SF

New Method: QuietRock QR-530 STC=54 (tested)

Per Room		Material per SF	Labor per SF	Per 8 SF assembly 8	Total Room Cost 517	
Corner wall & junction	LF	$ 1.83	$ 2.31	$ 4.14	$ 267.55	Assume four walls
Steel frame 3 1/2" 24" OC	LF	$ 0.17	$ 0.58	$ 6.00	$ 387.75	3 1/2" 24" OC
Acoustical sealant	SF	$ 0.42	$ 0.56	$ 7.84	$ 506.42	QS-350
QuietCoat	SF	$ 0.84	$ 0.06	$ 7.18	$ 464.01	QC-118
Insulation	SF	$ 0.30	$ 0.17	$ 3.76	$ 242.99	R-19
QuietRock	SF	$ 2.65	$ 0.56	$ 25.69	$ 1,659.89	QR-530 Serenity
Wall cost for typical hotel room with QuietRock					**$ 3,528.61**	Net SF
QuietRock more than Resilient Channel					**$ 1,472.48**	

Cost differential per room, old vs. new method		**Total cost/room**	**% increase**
Economy Hotel (0-1 star)		**$ 75,000.00**	**2.0%**
Average Hotel (2-3 star)	**Example →**	**$ 165,000.00**	**0.9%**
Luxury Hotel (4-5 star)		**$ 330,000.00**	**0.4%**

Pay-back period

The following table reveals the pay-back period is extremely short.

Cost to be recouped	**$1,472.48**				
Star rating	**1**	**2**	**3**	**4**	**5**
Revenue per night	**$ 50.00**	**$ 100.00**	**$ 150.00**	**$ 200.00**	**$ 250.00**
Payback (rental nights)	29.4	14.7	9.8	7.4	5.9
Annualized occupancy rate	8.1%	4.0%	2.7%	2.0%	1.6%

The payback to make an average room soundproof is approximately 10 days. The correct interpretation is that if soundproof rooms either avoid 10 nights of complaints and demand to be moved; or the hotel's reputation as being extraordinarily quiet generates and additional 10 nights of bookings over the lifetime of the room, the investment will be recouped.

Conclusion

The hotel owner, architects and acoustical consultants determined that the market demands STC 54 and sought the most cost-effective method to achieve that result. The old method using resilient channels cost $1,264 less per room. However, expert field experience demonstrates failure rates both during and post-construction of 60-90%. At risk therefore was $1,264 vs. failure to soundproof a room. The cost of guaranteeing a good result (i.e. STC 54) that cannot be sabotaged due to errors raises the cost of construction of an average room by 0.9% and is recouped in 10 days in an average hotel with average occupancy rates. Therefore, while the new technology is slightly more expensive during construction, it is ultimately far less costly as measured across a three-year economic horizon.