

# UNDERSTANDING THE TRIPLE LEAF EFFECT

If you have done some research on the topic of soundproofing, you may have come across commentary on “triple leaf walls”. In this document we’ll take a look at what a triple leaf wall is, and why they are very undesirable for any sound isolation application.

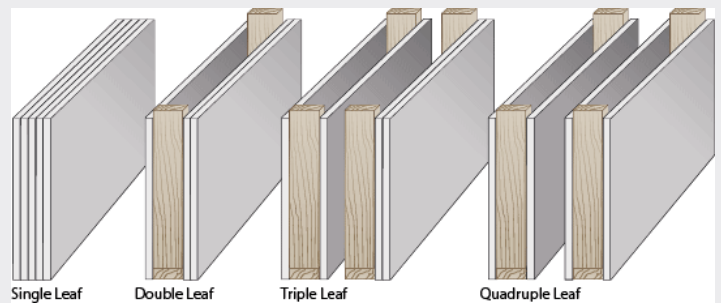
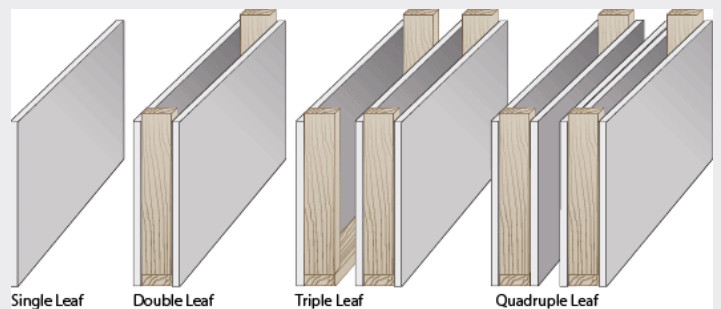
## WHAT IS A TRIPLE LEAF WALL?

A triple leaf wall is a wall with 2 air cavities, and not just one. Similarly, a quadruple leaf wall would be a wall with 3 air cavities. A leaf in a wall is a solid layer – like drywall – so another way of looking at it is that a triple leaf wall has 3 leaves.

Opposite we see single leaf (no air cavity), double leaf (like most walls), triple leaf and quadruple leaf constructions.

It is important to remember that if you use 2 layers of drywall directly against each other, it still only counts as one leaf because there is no air cavity between the layers.

In the sketch opposite we show again single through quadruple leaf walls, but this time they all have the same number of drywall layers.



## WHY IS A TRIPLE LEAF WALL A BAD THING?

It is not illogical to presume that the quadruple leaf wall above would have the best sound isolation. After all, the sound has to go through:

**Solid Mass – Air Space – Solid Mass – Air Space – Solid Mass – Air Space – Solid Mass.**

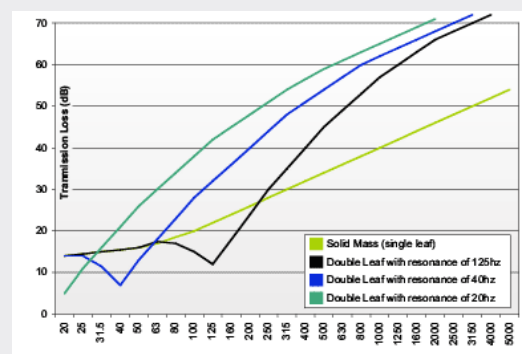
That quadruple leaf wall is decoupled 3 times over! While in a double leaf wall, it has to make it through only one air space, and in a single leaf wall there is no air space at all.

Well, while this makes sense, it is very false, especially at low frequencies. To understand why this is, we have to take a look at how decoupling works. Decoupling isn’t effective at all frequencies. If you take two layers of drywall, and separate them with an air space, it doesn’t improve things at all frequencies. The air in the cavity acts like a spring, and creates a resonance. Only well above this resonance do things improve (but then they improve very nicely indeed). Take a look at the graph below.

## EFFECT OF DECOUPLING A SOLID MASS

What you see is the sound-stopping power of the wall, in decibels, at different frequencies. This is called “transmission loss”. While this data is hypothetical, this is what occurs in real walls – the decoupling has a large positive effect at high frequencies, but a negative effect around the resonance.

To attain good low frequency performance, this resonance must be as low in frequency as possible – otherwise the weak point of your wall will fall at an unfavorable location, and low frequency noise will have little trouble passing through the wall. The goal of any decoupled wall should be to drive resonance down in frequency. To do this you have to



1. Add mass to one or both sides of the wall
2. Increase the depth of the air cavity
3. Add insulation (if you don’t have insulation)

## TRIPLE LEAVES ARE BAD

For a given amount of mass and space, they always have a higher resonance point than a double leaf wall.

One of the criteria that were given above for getting a low resonance point – and good low frequency performance – was a deep air space, with a lot of mass on either side.

The double leaf wall might have an air cavity depth of 8", but for the same overall net wall depth, the triple leaf wall's cavity will be just half that, and the quadruple leaf's cavities will be only 1/3 of the depth of the double leaf wall.

To make matters worse, each leaf in the double leaf wall is very heavy, but each leaf in the quadruple leaf wall is far lighter – half the mass. This will cause resonance to go up in frequency even more, and low frequency performance will be badly degraded.

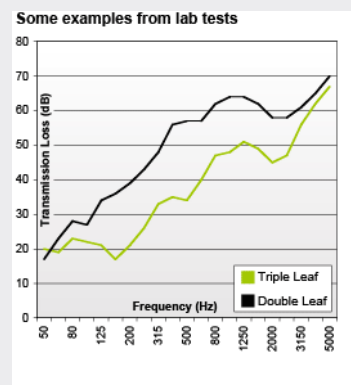
Multiple resonances / possibly more severe resonances. To further complicate things, a triple or quadruple leaf wall may exhibit more than one low frequency resonance – and if one is bad, then two or more are surely even worse.

Finally, the resonance behavior of multiple leaf walls isn't simple or entirely predictable, and may be more severe than with a double leaf wall.

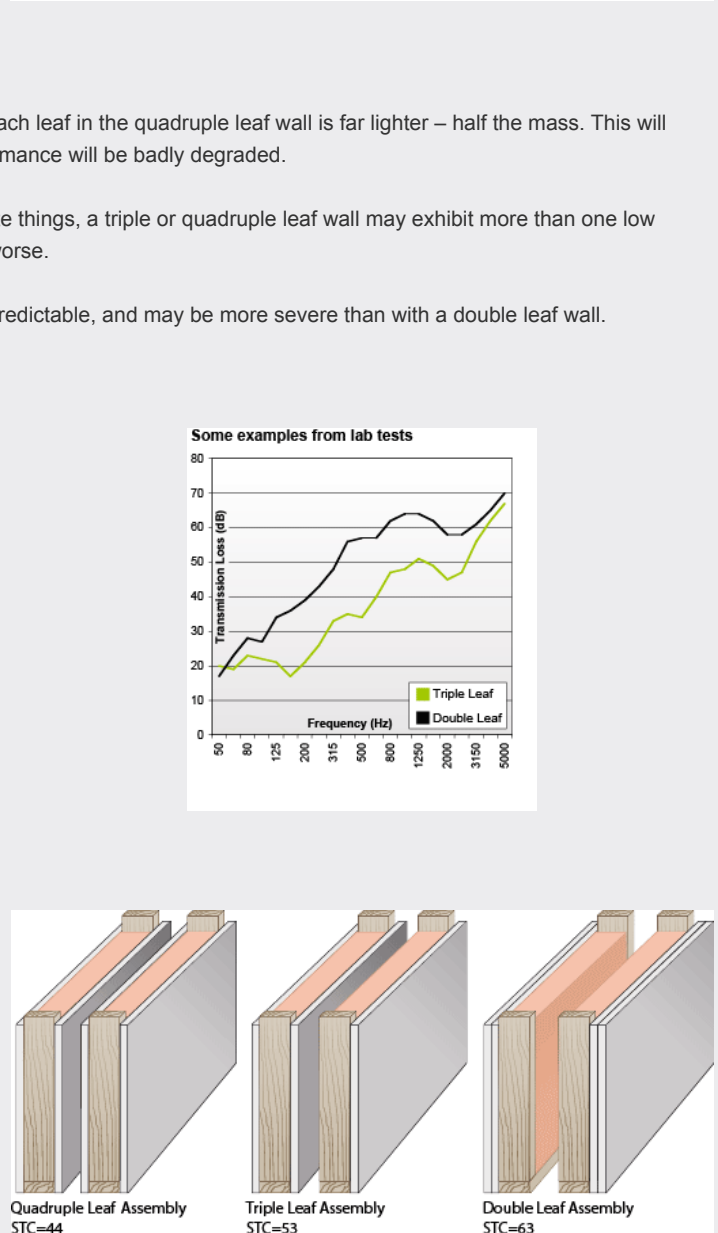
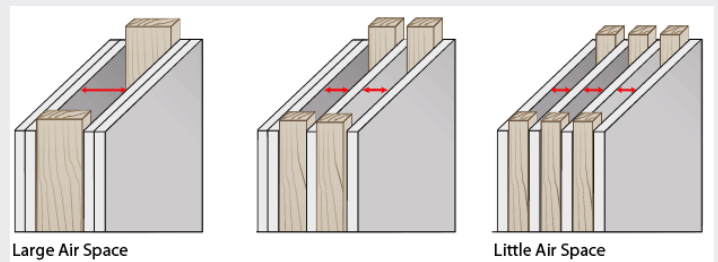
Next, let's take a look at just how bad triple leaf walls can perform relative to their double leaf counterparts.

These are tests TLF-95-107a (double leaf) and TLF-95-153a (triple leaf), taken from IR-811, a document published by the National Research Council of Canada. This data is copyright NRC Canada and shared with permission.

The difference here is stunning to say the least. It's even more remarkable when you consider that the same type of construction, and same type and amount of materials were used in each case.



The STC values shown opposite are from a series of tests run by Owens Corning in 1972 at Geiger and Hamme laboratories. While STC doesn't tell the entire story, the point is clearly made.



### SUMMARY

Triple leaf (or quadruple or higher # of leaf) constructions should be avoided like the plague. You will always get a lower level of sound isolation, and this loss may be most severe where you need performance the most – low frequencies. The Green Glue Company has a variety of such information available on the web site.