EFFECT OF INSUFFICIENT ADHESIVE ON ASTC PERFORMANCE IN CONCRETE PARTITIONS WITH LAMINATED DRYWALL

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1 Introduction

Based on experience of the authors, the sound isolating performance of properly cast concrete partitions is consistent and robust. However, it has been observed in the field that drywall layered on top of concrete partitions may, in some cases, have resulted in significantly degraded sound isolation performance of these partitions. This article presents a comparison of field measurements demonstrating the significant effects of insufficient adhesive to drywall-laminated concrete partitions, as well as "as-built" corrective methods to improve the sound isolating performance of drywall-laminated concrete partitions.

2 Background

In many concrete buildings, it is common to include a layer of laminated drywall on top of poured concrete partitions. While sound isolating performance of properly cast concrete can generally be consistently determined, the inclusion of laminated drywall may occasionally cause these partitions to underperform with respect to sound isolation.

A standard providing directions for application of gypsum board with adhesives to interior masonry or concrete walls (ASTM C-840 [1]) defines a measure of application of adhesives as follows:

When applying gypsum board to monolithic concrete, brick or concrete block, the adhesive shall be applied directly to the back of the gypsum board or on the wall in continuous beads not more than 12 in. (300 mm) on centers or daubs spaced not more than 12 in. (300 mm) on centers each way.

It has been frequently observed in the field that these directions are not frequently being followed, resulting in multiple variously sized cavities on both sides of drywall-laminated, poured concrete-partitions that are formed by the gaps between adhesive beads. This has resulted in concrete partitions, otherwise expected to exceed the requirements of the applicable building code, to underperform with respect to sound isolation. In some more extreme cases, this has resulted in concrete partitions failing to meet the requirements of the applicable building code.

3 Field measurements

Sound isolation measurements in the field (Sound Transmission Class, STC, as defined by ASTM E-336 [2]) show that drywall laminated concrete partitions occasionally drop in performance due to resonances localized to the surface of the drywall, within the 200-500 Hz frequency range. The resonant frequency, as well as the depth and width of the resonance, varies by case. This is considered to be relative to the effective size and depth of the cavities formed between the drywall surface and the porous concrete.

These gaps can often be observed in the field by tapping the drywall surface. Alternatively, any pockets of air between the laminated drywall and poured concrete wall can be detected by monitoring the sound field inside the receiving space during a sound isolation field measurement.

Measurement results, as tested by HGC Engineering on recent projects, are shown in Figure 1. These measurement results were obtained from condominium buildings as part of an assessment of their compliance with the building code requirement of STC-50. Published laboratory measurement data for a poured bare 200 mm thick concrete wall was obtained and included for comparison [3].

It should be noted that in field conditions, flanking paths and other deficiencies exist, including the presence of other voids in the concrete or its surface. However, the test results presented below are field test results that were each clearly noted to be affected by the effect of insufficient lamination of drywall.

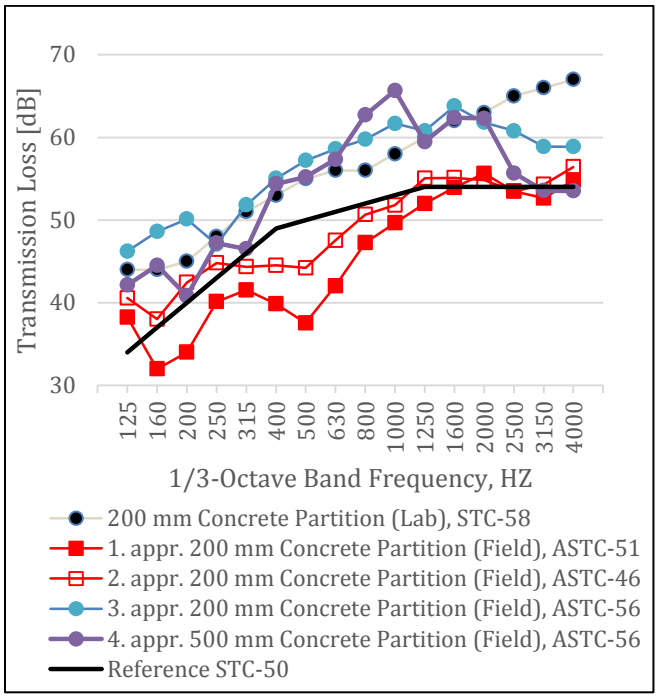

Figure 1: Transmission loss results

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4 Discussion

4.1 Observations

As can be seen from Figure 1, test number 1 is clearly limited by a resonance centering at the 500 Hz range, with a rating of ASTC-46, which did not meet the STC-50 requirement of the applicable building code. Test number 2 shows a similar, although less steep resonance with a result of ASTC-51, which just passes the requirement of the building code.

Test number 3 shows a result that is within the expected performance of the partition. It should be noted that even when applying adhesives as per the ASTM-C840, cavities are still formed, although the tighter grid translates to an absence of the resonance.

An extreme case is test number 4, a 500 mm thick poured concrete wall with both a theoretical performance of well STC-60, as well as an expected field performance of over STC-60, considering typical flanking paths within a concrete building. This assembly performed in the field with a rating of ASTC-56. The performance was mostly limited by observed insufficient drywall lamination on both sides of the assembly.

4.2 Mitigation considerations

As a mitigative effort, most direct solution would entail removing the drywall layer and reapplying the adhesive as per the ASTM-standard. At the time of this paper, no field test data for a wall following such procedure was available. However, the authors are expecting to perform such a test in the near future.

Removing and reinstalling a complete layer of drywall is not always the most cost-effective solution, and other solutions have been observed at construction sites to mitigate this poor lamination condition. In one instance, instead of removing the drywall layer in a finished and occupied condominium, a contractor has decided to fasten the insufficiently laminated drywall layer by using concrete nails at a 150-mm grid, resulting in approximately 700 nails being added to a small bedroom assembly. This solution reduced the drywall-to-concrete cavity size significantly, thus, effectively damping the resonance and ultimately increasing the sound isolation performance. While this measure only raised the STC performance it by six points, this resulted in a rating of ASTC-52, which passes the requirements of the building code.

5 Conclusions

The foregoing confirms that drywall layered on top of concrete partitions degrades the partitions' sound isolating performance when insufficient amounts of adhesive is applied. A degradation from the resulting cavities was demonstrated to reduce the ASTC-ratings in some extreme cases by 10 points in respect to the expected field-test value of concrete partitions. Mitigation without removal and reinstallation has not been shown to be highly effective, but may be sufficient in many cases.

References

[1] ASTM C840-16, Standard Specification for Application and Finishing of Gypsum Board, ASTM International, West Conshohocken, PA, 2016, www.astm.org

[2] ASTM E336-11, Standard Test Method for Measurement of Airborne Sound Attenuation between Rooms in Buildings, ASTM International, West Conshohocken, PA, 2011, www.astm.org

[3] C.M Harris, Noise Control in Buildings, a guide for architects and engineers, 1994.