PLITEQ INC. – 2015 RESEARCH IN ARCHITECTURAL ACOUSTICS

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Résumé

Pliteq Inc. est une société d'ingénierie basée à Toronto spécialisée en acoustique architecturale. Le PDG Paul Downey est répertorié comme l'inventeur de 7 brevets d'atténuation liées au son et aux vibrations. Les lignes de produits GenieMat™ et GenieClip™ sont testés pour leur efficacité sur différentes structures pour diverses applications utilisant des laboratoires tiers indépendants et des procédures de test tel que définie par l'ASTM. En 2015, plusieurs programmes d'essais furent complétées, les résultats sont présentés dans cet article. Les sujets de recherche inclus l'évaluation de la performance de; GenieMat™ FIT produits de revêtement de sol pour l'isolation contre les impacts lourds, l'utilisant d'un système de plusieurs couches de GenieMat™ FF pour obtenir une faible fréquence naturelle et une rigidité dynamique des planchers flottants, en utilisant la GenieClip™ pour réduire les bruits d'impact dans la construction à ossature de bois et, enfin, en utilisant tous les types de produits mentionnés ci-dessus pour réduire la transmission des bruits d'impacts et sons aériens dans les construction utilisant le bois lamellé-croisé (CLT).

Mots-clés: isolation impact lourd, IIC, STC, CLT, atténuation acoustique

Abstract

Pliteq Inc. is a Toronto based engineering company specializing in architectural acoustics. CEO Paul Downey is listed as the inventor of 7 sound and vibration mitigation related patents. The GenieMat™ and GenieClip™ product lines are tested for efficacy on various structures for various applications using independent third party laboratories and ASTM test procedures. In 2015 we completed numerous test programs and the findings are presented in this article. Research topics included assessing the performance of; GenieMat™ FIT flooring products for heavy impact isolation, using multi-layer GenieMat™ FF systems to achieve low natural frequency and dynamic stiffness response of floating floors, using the GenieClip™ to reduce impact sound in wood frame construction and finally using all of the above mentioned product types to reduce impact and airborne sound transmission in cross-laminated timber (CLT) construction.

Keywords: heavy impact insulation, IIC, STC, CLT, sound attenuation

1 Introduction

In 2015 engineers at Pliteq Inc. completed more than 100 independent laboratory acoustical tests to determine improvements in impact and airborne sound attenuation as a result of using various products on different structures. The information was presented in numerous papers completed for INTER-NOISE 2015 proceedings in San Francisco. A summary of the work completed for the purpose of those papers is provided here.

2 Research Topics and Test Programs

2.1 Performance of fitness flooring assemblies

Fitness facilities around the world are increasingly more prevalent in mixed use buildings and on the second floor and above. Consequently, vibration in structures as a result of heavy weight drops is a growing and challenging engineering problem. Data was collected from heavy weight drops on a wide variety of impact vibration reducing floor types [1]. These include floating plywood systems and various fitness flooring surfaces. We compared the results of using input from a tapping machine to much higher energy input sources such as heavy/soft and heavy/hard (7 kg and 45 kg) impact sources. Both acoustic and vibration data was obtained. The figure below is an example taken from the study.

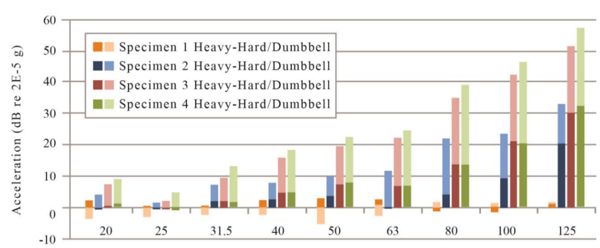

Figure 1 – Acceleration deltas normalized off the 8mm baseline product

2.2 Effect of impact sound transmission

Experiments were used to collect data from impact testing on different variations of typical fire-rated components in open-web wood truss assemblies [2]. Data was obtained by performing ASTM E492 test methodology in a laboratory environment. A comparative analysis was presented for

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three different scenarios. The effects of changing the channel spacing of the drywall isolation clips, the effects of adhered vs. floating vinyl flooring with a resilient rubber underlayment, and the effects of an assembly with and without a layer of poured gypsum underlayment. All data is presented in table and plot format and the relevant 1/3 octave band data is analyzed. An example of one of the test assemblies is below.

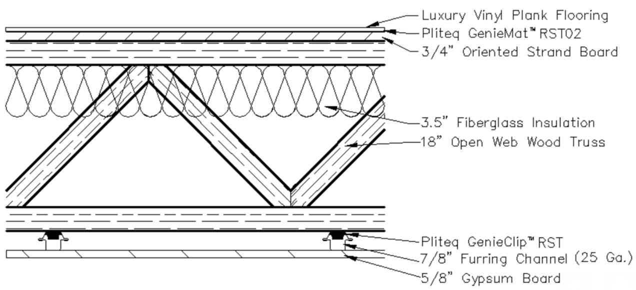

Figure 2 – Section view of the tested open web truss floor assembly

2.3 Performance of Re-bonded Recycled Rubber Underlayment

The use of re-bonded recycled rubber to form a compressible elastomeric noise control underlayment for architectural noise control is well known [3]. This includes the use of single and dual layered underlayment with and without a repeating bi-directional sinusoidal bottom surface (GenieMat^{TM} FF). Until now these dual layer systems used two identical thickness mats with the same wavenumber sinusoidal patters. Recent experimentation into the dynamic stiffness of various combinations of layers of different thicknesses hinted that greater performance might be achieved with two mismatched layers. This paper will correlate the dynamic stiffness of the underlayment combinations with the Impact and Airborne Sound Transmission in laboratory environments. « Table 7 below is taken from the study and shows the improved dynamic properties resulting from the mismatched layers.

Table 1 – Apparent dynamic stiffness, s't, for various sinusoidal profiled rubber interlayer configurations

No. layers	Configuration	Total Thickness (mm)	Average Dynamic Stiffness (MN/m^3)	Average Resonant Frequency (Hz)
1	6	6	37	68
1	10	10	25	55
2	6 + 6	12	20	51
2	10 + 6	16	8	32
1	17	17	15	44
2	10 + 10	20	12.6	40
1	25	25	13	41

2.4 Performance of cross-laminated timber panel construction

Cross laminated timber panels (CLT) are a relatively new method of constructing multi-family structures in North America [4]. The panels are composed of numerous layers of wood, each perpendicular to the adjacent layers. Wood is a renewable resource and producing the components of CLT panels consumes roughly half of the energy of concrete. 12-storey buildings are possible with cross-laminated timber. While this has been used in other parts of the world, it has not yet been widely adopted in North America. In an effort to better understand how a CLT floor ceiling structure will perform in impact and airborne sound attenuation testing, we constructed a 175mm thick floor assembly in the laboratory and conducted numerous tests (STC-ASTM E90 and IIC-ASTM E492) with different floor toppings and with and without a ceiling assembly. Plywood installed over resilient underlayment of various thicknesses was tested in addition to finish floor installed directly over resilient underlayment. A resiliently mounted ceiling with insulation was also tested. The test data collected is compared to other labs including testing done by the National Research Council of Canada (NRC). As a result of the test program we can hope to design IBC section 1207 code compliant CLT assemblies, better understand lab variations with this type of structure and compare it to conventional concrete slabs of equivalent thickness. A summary table from the study is shown below.

Table 2 – Overall STC and IIC performance of various CLT assemblies

Test Report #	Assembly	STC	IIC
E5958.01	Bare 175mm CLT	39	25
E5958.02	GenieMat™ FF10 + ¾" Advantech	43	41
E5958.03	GenieMat™ FF10 + 2 x ¾" Advantech	45	42
E5958.04	GenieMat™ FF25 + 2 x ¾" Advantech	48	44
E5958.05	GenieMat™ FF25 + 2 x ¾" Advantech w/ ceiling	61	55
E5958.06	Bare CLT w/ ceiling	58	45
E5958.07	Vinyl Plank on GenieMat™ RST05 w/ ceiling	58	58
E5958.08	Vinyl Plank w/ ceiling	57	54

References

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