FIELD IMPACT INSULATION CLASS (FIIC) TESTING OF HARDWOOD FLOORING ON A VARIETY OF RESILIENT UNDERLAYMENTS IN A CONCRETE CONDOMINIUM BUILDING

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1. INTRODUCTION

The use of hardwood flooring in new condominium buildings and the replacement of carpeting with hardwood flooring in existing buildings can result in inadequate impact noise insulation between vertically adjacent units. In Victoria, many condominium developers and strata councils are grappling with the decision of whether or not to allow hardwood floors in their buildings. This typically proves to be a difficult decision. If the developer or strata council do not permit the installation of hardwood flooring they risk turning away prospective buyers or dissatisfying strata members. If they do, they risk the creation of a serious noise problem which, in *Wakefield Acoustics Ltd.'s* experience, can lead to persistent noise complaints and, in some cases, threats of legal action.

This paper presents the results of a series of FIIC tests *Wakefield Acoustics Ltd.* recently conducted in a concrete condominium building in Victoria, B.C. The tests were conducted to assist a developer in deciding whether or not to allow the use of hardwood flooring in the building. Nine FIIC tests were conducted in which a sample of hardwood flooring was placed upon nine different resilient underlayments. A tenth test was conducted where a different sample of hardwood flooring was placed upon one of the previously tested underlayments.

2. METHODOLOGY

The ten FIIC tests were conducted in accordance with ***ASTM E 1007-04^{e1}*** with the following exceptions:

1. The hardwood flooring and underlayment samples did not cover the entire test room floor. This discrepancy may have affected somewhat the resulting impact noise spectra measured in the receiving room.

2. The volume of the receiving room was smaller (46 m^3) than required by the standard (60 m^3).

3. The tapping machine was not operated in four different positions because the hardwood flooring and underlayment samples did not provide sufficient area for multiple positions.

The tests were conducted with a CESVA MI005 Tapping Machine which conforms to the specifications of ISO 140-6, 140-7 and 717-2. All sound level measurements were performed using a Larson-Davis 2800 Real Time Analyzer - a Type 1 sound level meter. The "test floor" consisted of an approximately 1.22 m x 1.83 m sample of hardwood flooring placed over an underlayment sample on a 203mm concrete slab. The hardwood and underlayment samples were simply placed on the concrete surface and were not adhered to either the concrete or each other.

The types of underlayments tested were as follows:

1. Acoustitech Premium
2. Acoustitech Maxima
3. Durason
4. Silanzer LJ
5. Safe and Sound
6. Acoustik
7. Echo Silencer
8. Thick Cork
9. KRAUS

For these nine tests, a 14 mm thick sample of *Giorgina Engineered Hardwood* was placed over the underlayments. For the tenth test, an 8 mm thick sample of *James River Collection Prefinished Hardwood* was placed over the *Acoustitech Premium* underlayment.

3. RESULTS

Table 1 and Figure 1 present the results of the FIIC tests.

Test #	Hardwood	Underlayment	Field Impact Insulation Class (FIIC)
1	14 mm Giorgina Engineered Hardwood	Acoustitech Premium	57
2	14 mm Giorgina Engineered Hardwood	Acoustitech Maxima	57
3	14 mm Giorgina Engineered Hardwood	Durason	58
4	14 mm Giorgina Engineered Hardwood	Silanzer LJ	57
5	14 mm Giorgina Engineered Hardwood	Safe and Sound	58
6	14 mm Giorgina Engineered Hardwood	Acoustik	58
7	14 mm Giorgina Engineered Hardwood	Echo Silencer	59
8	14 mm Giorgina Engineered Hardwood	Thick Cork	58
9	14 mm Giorgina Engineered Hardwood	KRAUS	58
10	8 mm James River Collection Prefinished Hardwood	Acoustitech Premium	60

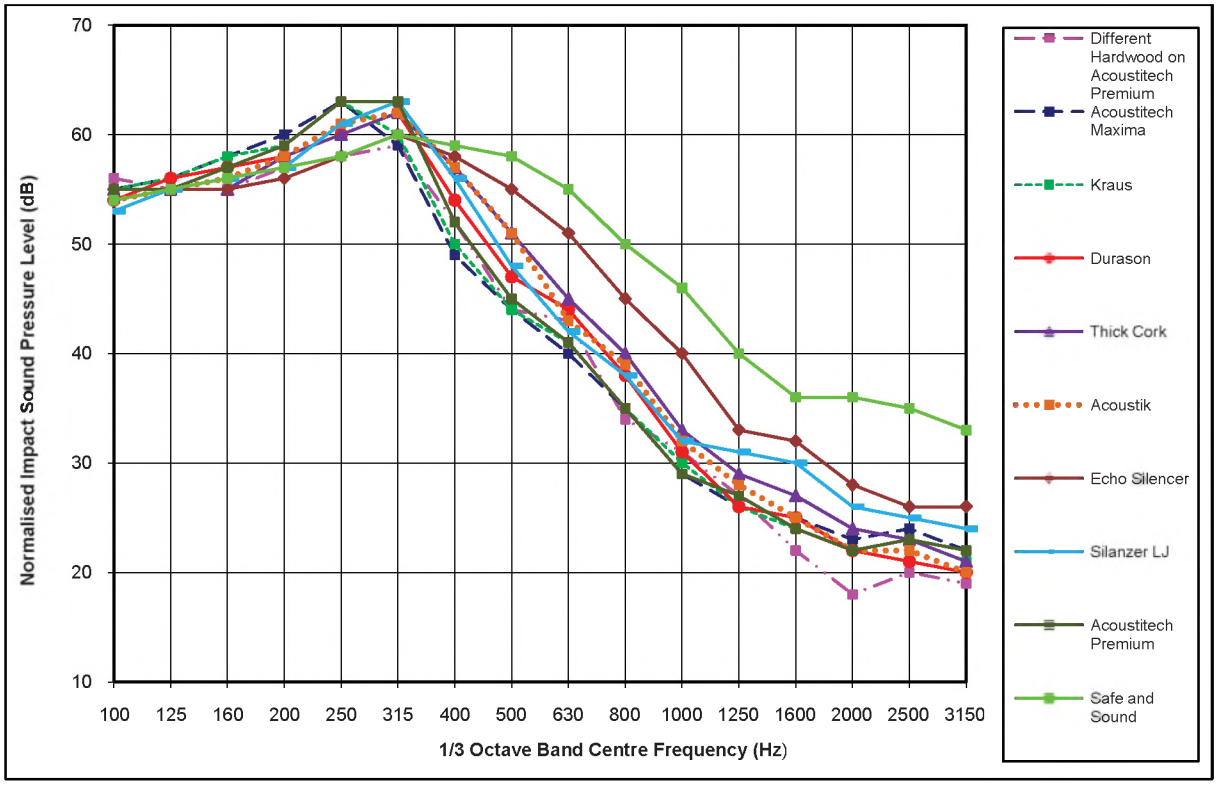

Fig. 1. Comparison of the Normalized Impact Sound Pressure Levels of the ten FIIC tests

4. DISCUSSION

Comparison of Underlayments

From Table 1 it can be seen that the FIICs achieved when the *Giorgina Hardwood* sample was placed over the various underlayments range from 57 to 59. This uniformity in FIIC ratings can be explained by referring to Figure 1 where it can be seen that there is a "spike" in the Normalized Impact Sound Pressure Levels (NISPLs) within the 250 and 315 Hz one-third octave bands. This "spike" controlled the FIIC rating of all the underlayments tested. While there is little variation in the FIIC ratings, there is some variation in the NISPLs, and particularly at frequencies above 400 Hz. So despite the underlayments achieving very similar FIIC ratings, the "character" of the impact noise experienced will vary. For example, while the *Safe and Sound* and *Thick Cork* underlayment both achieved FIIC ratings of 58, it can be seen that the NISPLs measured with *Safe and Sound* are significantly greater than those of the *Thick Cork* at frequencies above 400 Hz. As such, impact noise experienced beneath a concrete floor surfaced with hardwood flooring would have a much "brighter" character if the underlayment used were *Safe and Sound* rather than *Thick Cork*.

Comparison of Hardwoods

The tenth test conducted involved retesting the *Acoustitech Premium* underlayment with a different hardwood sample (8 mm *James River Collection Prefinished Hardwood* instead of 14 mm *Giorgina Engineered Hardwood*). It can be seen from Table 1 that changing the hardwood resulted in a 3 point improvement in the FIIC. It is interesting to note that the biggest improvements (4-5 dBA) occurred within the 250 and 315 Hz bands where the "spike" in NISPLs was observed. While it cannot be known for certain why the change in hardwood had such an effect, it may be that the 250 / 315 Hz "spike" was more a function of the resonant frequency of the hardwood samples than any properties of the underlayments. The small sample size of the hardwood flooring may have also influenced the 250 / 315 Hz spike. If the hardwood and underlayment had been actually installed (i.e. adhered to and covering the entire concrete floor), the resonant frequency of the hardwood would most likely be lower in both frequency and magnitude.

Wakefield Acoustics Ltd. typically recommends that, to avoid significant impact noise annoyance, the FIIC of a floor/ceiling system should at least exceed 60 and preferably exceed 65. Based upon these tests, however, it is unclear whether an FIIC of 60 can be consistently achieved, or whether an FIIC of 65 can be achieved at all, when hardwood flooring is used in a concrete building.