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Measurement of Airborne Sound Insulation of 8 Wall Assemblies
Measurement of Airborne and Impact Sound Insulation of 29 Floor Assemblies

Nordic Engineered Wood

Report No. A1-006070.10

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Summary

The following report contains the Transmission Loss (TL) results measured in accordance with ASTM E90-09 of 8 cross-laminated timber (CLT) wall assemblies and the TL results and normalized impact sound pressure level results measured in accordance with ASTM E492-09 of 26 CLT floor assemblies and 3 glulam floor assemblies.

Reference tables containing the specimen number, sketch, short description, rating(s) as well as the page number of all the assemblies tested are found starting on page 16.

The wall assemblies were built and tested between November and December 2014. The specimen descriptions and the reported mass per area of the 8 wall assemblies that were previously published under report numbers A1-006070.1 to A1-006070.8 have been revised in this report.

The floor assemblies were built and tested between December 2014 and June 2015. The specimen description and the reported mass per area of floor specimen A1-006070-11F that were previously published under report number A1-006070.9 have been revised in this report.

The following discussion section contains analyses and graphical comparisons of the tested wall and floor assemblies used to highlight key findings:

1. In-situ TL vs. Laboratory TL Results
2. TL Results of Current Bare Assemblies vs. Previous Assemblies
3. TL Results of Walls vs. Floors
4. TL Results of CLT Walls
5. TL Results of CLT Floors
6. TL Improvement of Toppings and Resilient Membranes
7. TL Difference of Poured vs. Precast Concrete Topping
8. TL Interpolation for Floor Toppings
9. TL Improvement of Floor Coverings
10. TL Improvement of Hung Ceilings
11. TL Results of Glulam Floors

The last three pages of this report contain additional test setup information for each facility.

APPENDIX: ASTM E90-09 – Airborne Sound Transmission – Wall Facility

APPENDIX: ASTM E90-09 – Airborne Sound Transmission – Floor Facility

APPENDIX: ASTM E492-09 – Light Impact Sound Transmission – Floor Facility

1. In-situ TL vs. Laboratory TL Results

The laboratory sound insulation results measured according to ASTM E90 and ASTM E492 represent an upper limit to the direct sound insulation in the field. A variety of other factors influence the in-situ performance, for example flanking sound transmission, specimen size, specimen coupling, and construction workmanship.

2. TL Results of Current Bare Assemblies vs. Previous Assemblies

The CLT 5 ply 175 mm thick wall and floor have been measured twice in the NRC acoustic laboratories, once in 2012 and once in 2015.

Rebuild repeatability may be defined as the closeness of agreement between results obtained with the same test method in the same laboratory on nominally identical test specimens constructed with nominally identical materials.

The results of the bare floor assembly measured in 2012 and 2015 are shown in Figure 1. Although the CLT panels were nominally of the same area density (91 kg/m^2), the panels were different and were joined differently for the two separate tests. The floor assemblies achieved STC ratings of 41 and 42, with TL variations of up to 3 dB.

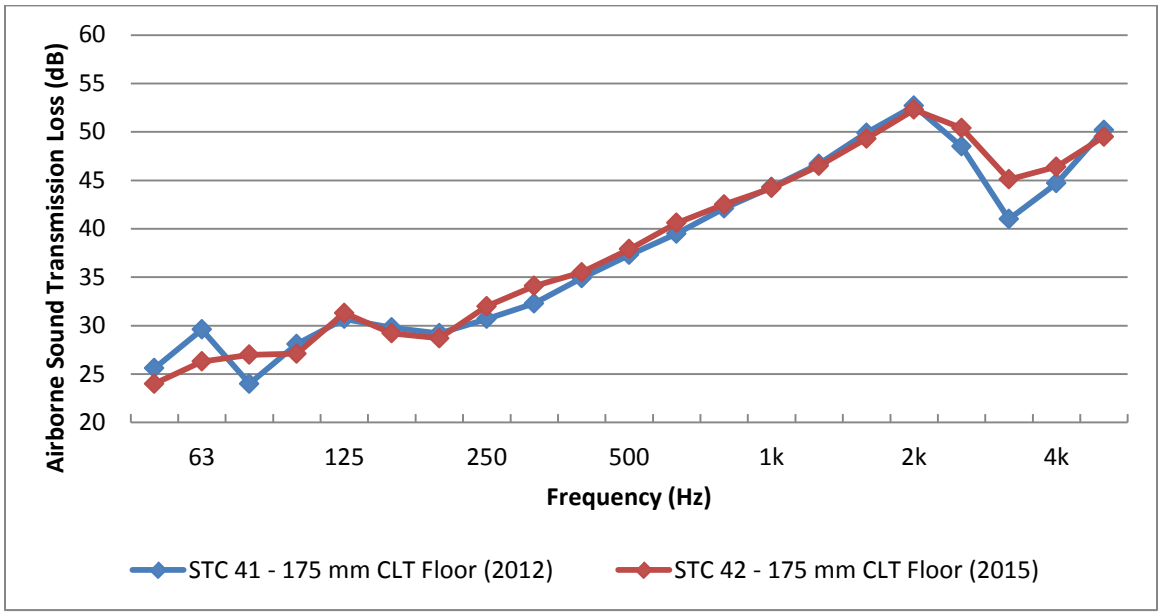


Figure 1 – Bare Cross-Laminated Timber Floors

The results of the bare wall assembly measured in 2012 and 2015 are shown in Figure 2. The CLT wall panels were different and were joined differently for the two separate tests. The wall assemblies achieved STC ratings of 39 and 37, with TL variations of up to 4 dB, mainly below 400 Hz.

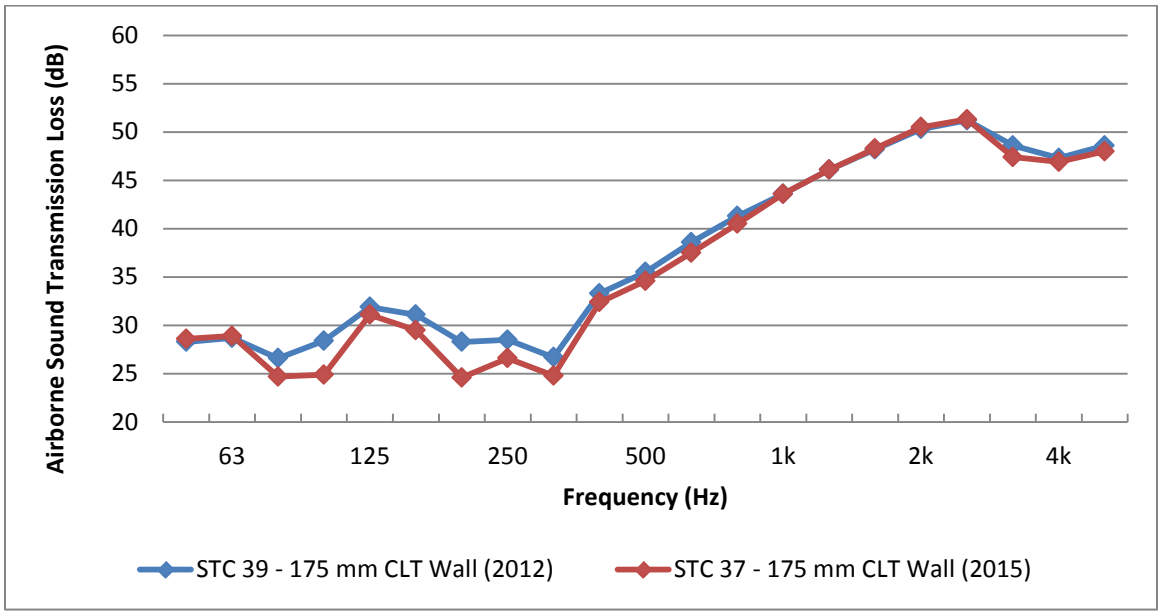


Figure 2 – Bare Cross-Laminated Timber Walls

Based on the floor and wall results, it would be reasonable to expect a variation in STC of ±2 points for the bare CLT assemblies. The rebuild repeatability of CLT assemblies with linings (decoupled wall boards, toppings and ceilings) has not been established.

3. TL Results of Walls and Floors

The comparison between the TL values of the bare CLT assembly (CLT 5 ply 175mm thick) measured in the Wall Sound Transmission Facility and the Floor Sound Transmission Facility reveals that they are not exactly the same (Figure 3). The difference between the bare wall and bare floor assemblies may be attributed to edge mounting/conditions and loading (gravity). Similar differences were also observed during the test series in 2012 as seen in Figure 4.

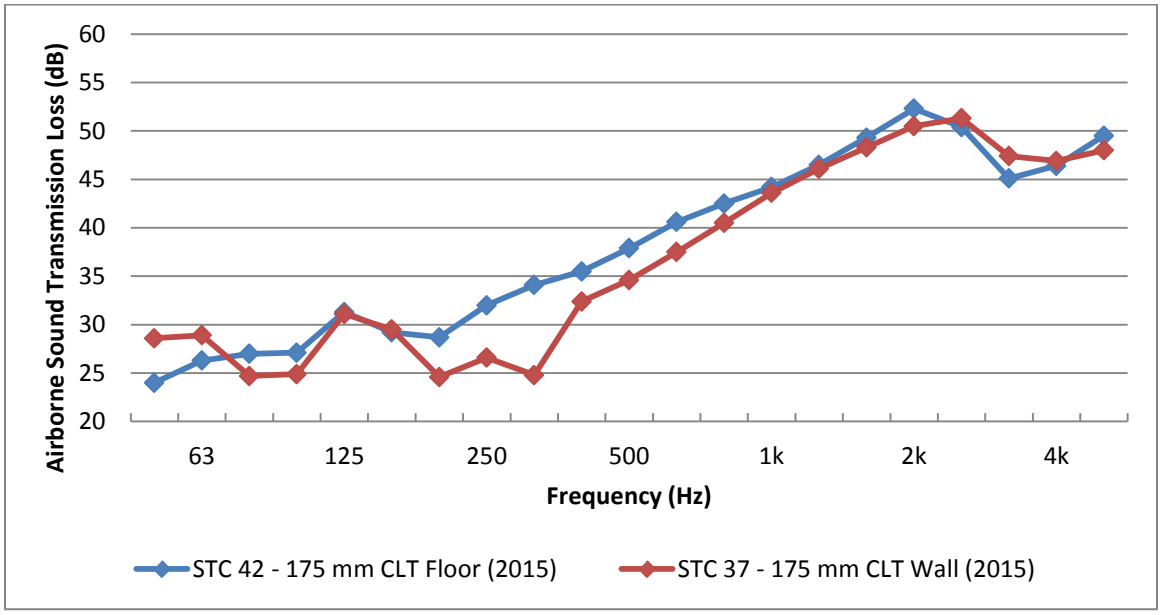


Figure 3 – Bare Cross-Laminated Timber Wall and Floor (2015)

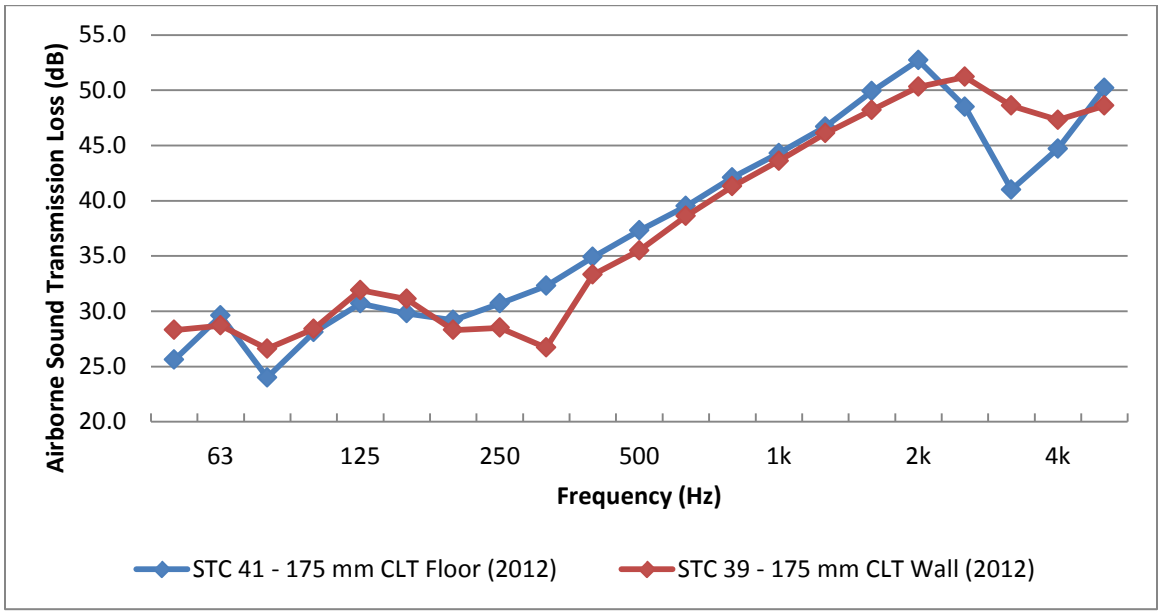


Figure 4 – Bare Cross-Laminated Timber Wall and Floor (2012)

4. TL Results of CLT Walls

There were 8 CLT wall assemblies with a base 5-ply CLT (175 mm thick) tested in the NRC Construction Wall Sound Transmission Facility as part of this series. The base CLT wall assembly had linings added to it such as a gypsum board on Z-channels or various decoupled steel stud walls.

The sound insulation performance of the walls tested varied between STC 37 for the bare CLT 5-ply (175 mm thick) and STC 71 for a wall with Z channels and a decoupled steel stud wall. In order to achieve an STC rating of at least 50, the CLT wall must have a lining on at least one side composed of gypsum board separated by at least 38 mm from the CLT surface. All of the walls tested with this type of lining (08W to 14W) achieved an STC rating of 53 or higher. Adding layers of directly attached gypsum board on the other side of the wall did not further improve the STC ratings.

5. TL Results of CLT Floors

In total, 16 CLT floor assemblies with a base 5-ply CLT (175 mm thick) and 10 CLT floor assemblies with a base 5-ply CLT (131 mm thick) were tested in the NRC Construction Floor Sound Transmission Facility for this project. Various toppings, coverings and dropped ceilings were tested in combination with the two bare floors to examine their effect on the sound insulation performance.

6. TL Improvement of Toppings and Resilient Membranes

As shown in Figure 1, the bare CLT 5-ply (175 mm thick) floor achieves a STC rating of 42. The bare CLT 5-ply (131 mm thick) floor achieves a STC rating of 39. The addition of a concrete or heavy topping (100+ kg/m^2) on a resilient membrane (e.g. INSONOMAT or Owens Corning QuietZone mat) to either of these bare floor assemblies yields an STC rating of at least 50. Improving impact isolation is more difficult. With a covering such as an engineered floating floor or laminate with a good underlay or tiled carpet, IIC values in the low 50s can be reached.

The addition of a precast concrete topping on the 5-ply CLT (175 mm thick) floor increases the STC by 12 to 14 points depending on the resilient material placed underneath (Figure 5). The best performing material is the rubber membrane (INSONOMAT) followed by the closed cell foam (Owens Corning QuietZone mat) and the tar boards.

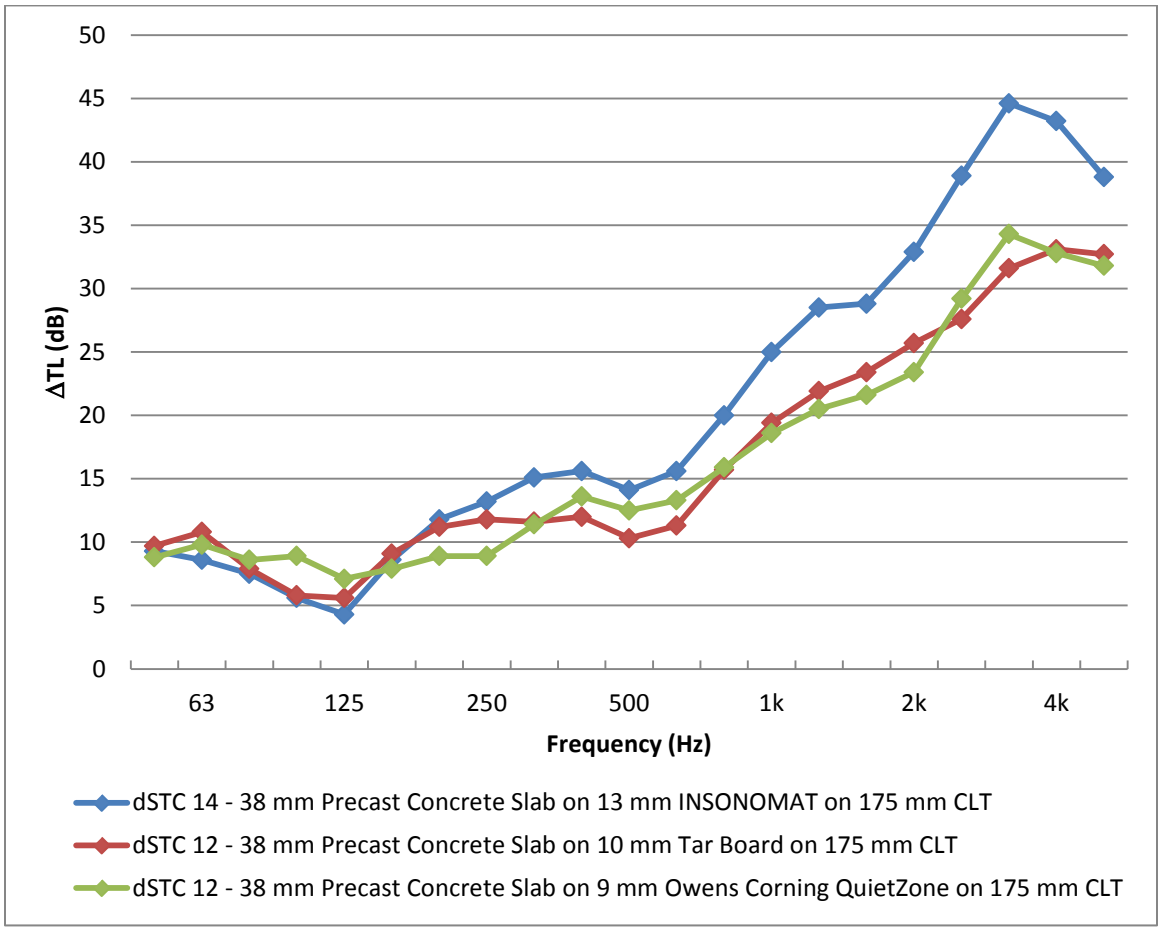


Figure 5 – Improvement due to 38mm precast concrete topping on resilient membranes on 175 mm CLT

The same topping and resilient membranes were also installed on the 5-ply CLT (131 mm thick) floor. The improvements due to the toppings are slightly better than on the 175 mm thick CLT floor (Figure 6).

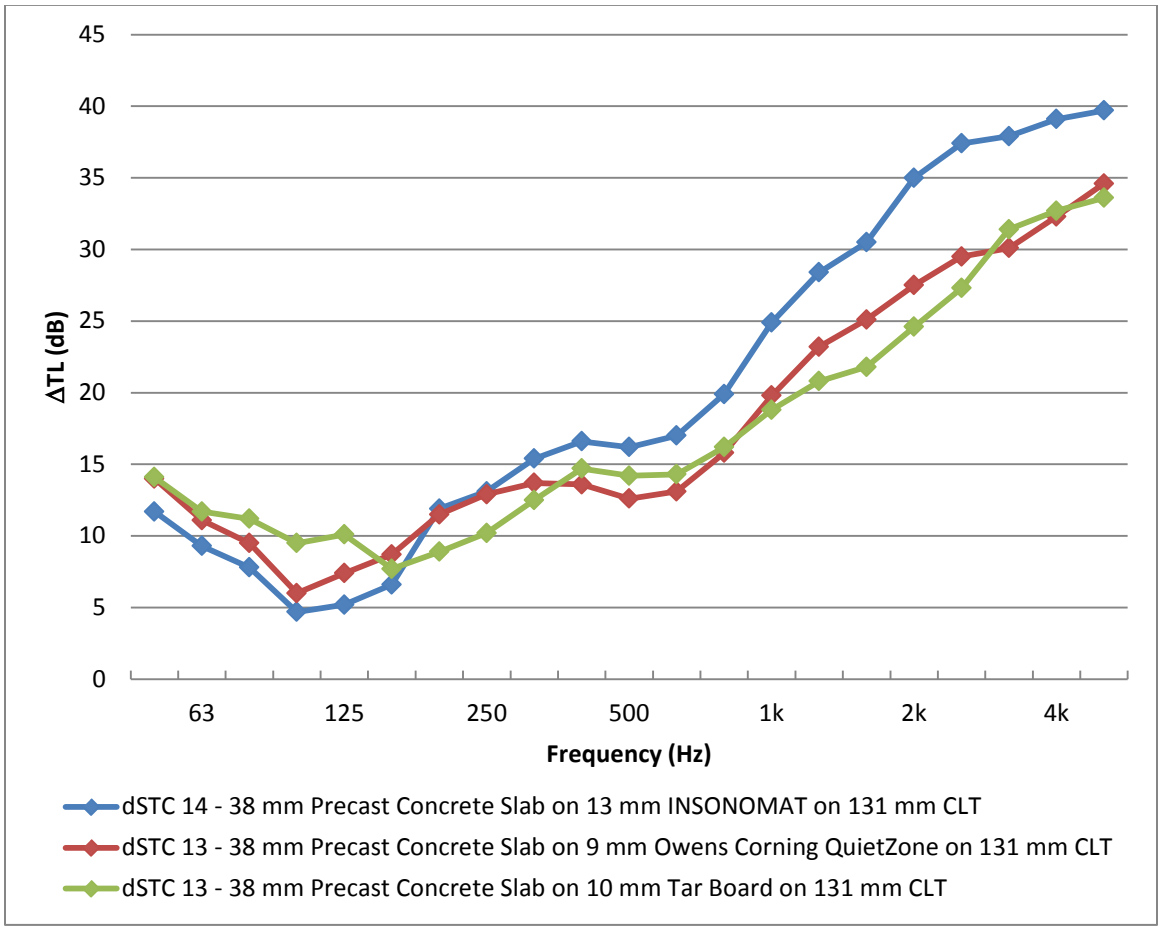


Figure 6 - Improvement due to 38 mm precast concrete topping on resilient membranes on 131 mm CLT

Comparing the improvement of INSONOMAT under two different precast slabs thicknesses (see Figure 7), it can be observed that the relative improvement is very similar (an increase of 14 points) for the 38 mm precast concrete slab on both 131 mm and 175 mm thick CLT floors and with the 70 mm precast mortar topping on 131 mm thick CLT. The 70 mm precast mortar topping on the 89 mm glulam assembly performs much better (an increase of 18 points) than other base CLT assemblies due to the fact that the bare glulam only gets an STC 33.

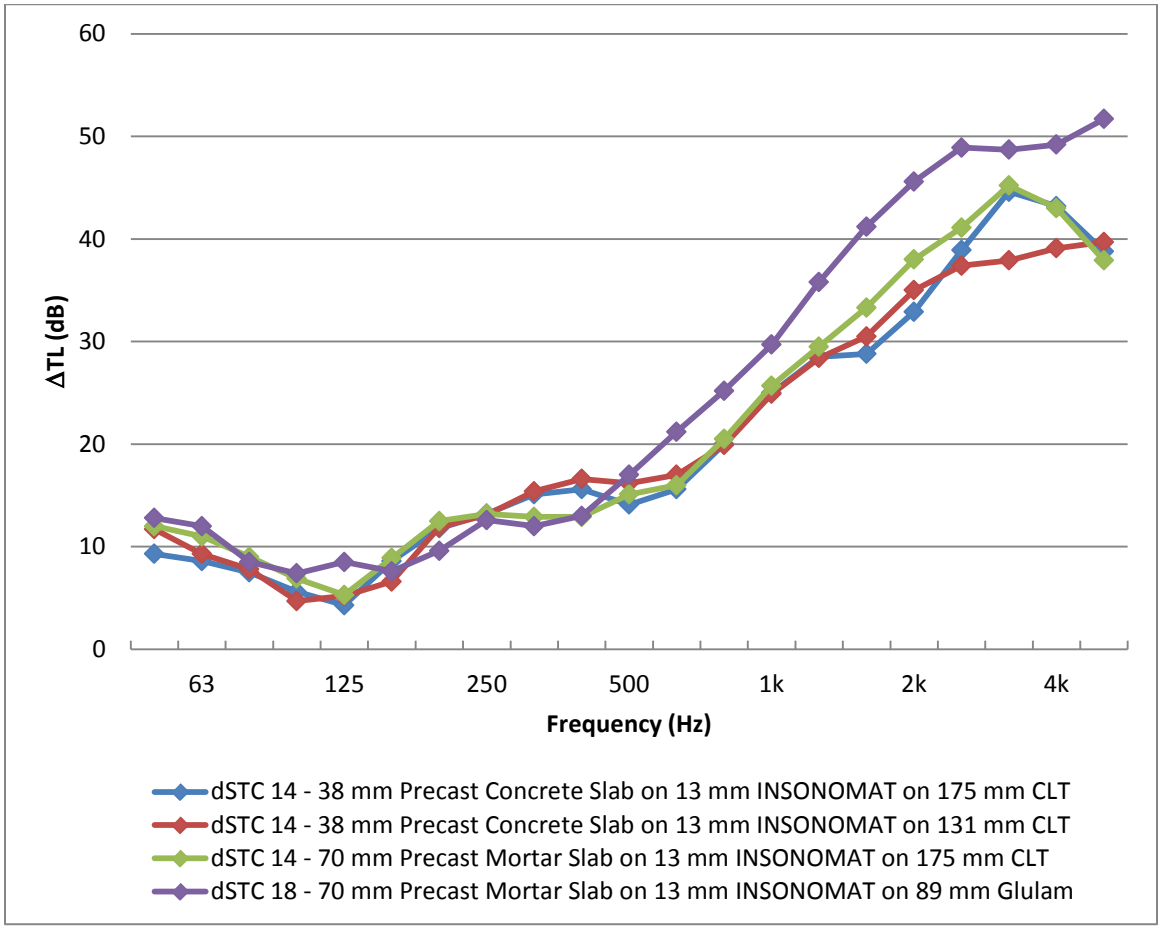


Figure 7 - Improvement for rubber membrane (INSONOMAT) installed under various topping slabs

7. TL Difference of Poured vs. Precast Concrete Topping

Most of the floor assemblies were tested using a precast concrete slab of nominal thickness of 38 mm (103 kg/m^2) to simulate a poured topping as installed in the field. One assembly was also tested with a poured concrete topping. The poured concrete topping on tar board obtained an STC 47 compared to an STC 52 for the 38 mm precast concrete topping (see Figure 8). The STC rating in both cases is limited at 400 Hz.

In the past, floor assemblies with a poured gypsum concrete topping on a closed cell foam (see Figure 9) obtained better results when compared with the precast slab (STC 53 vs STC 57).

The field performance of a poured topping on tar boards could be up to 5 STC points worse than laboratory results. It is expected that the field performance of a poured topping on either Owens Corning QuietZone or INSONOMAT would be within ±2 STC points of the laboratory results.

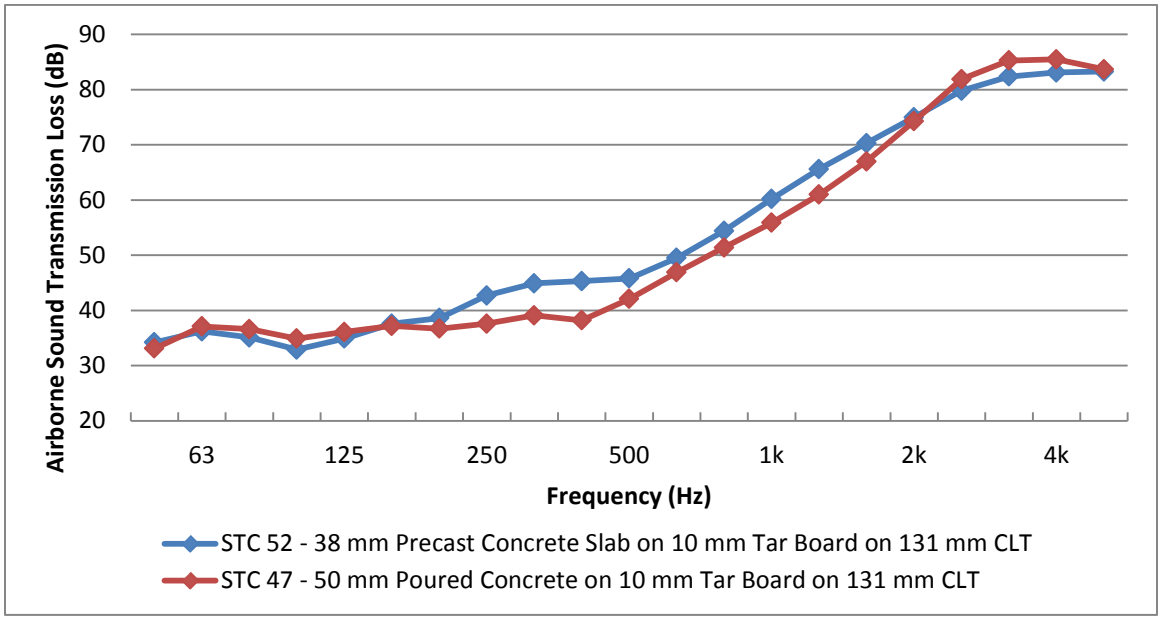


Figure 8 – Precast concrete slab vs. poured in place concrete slab

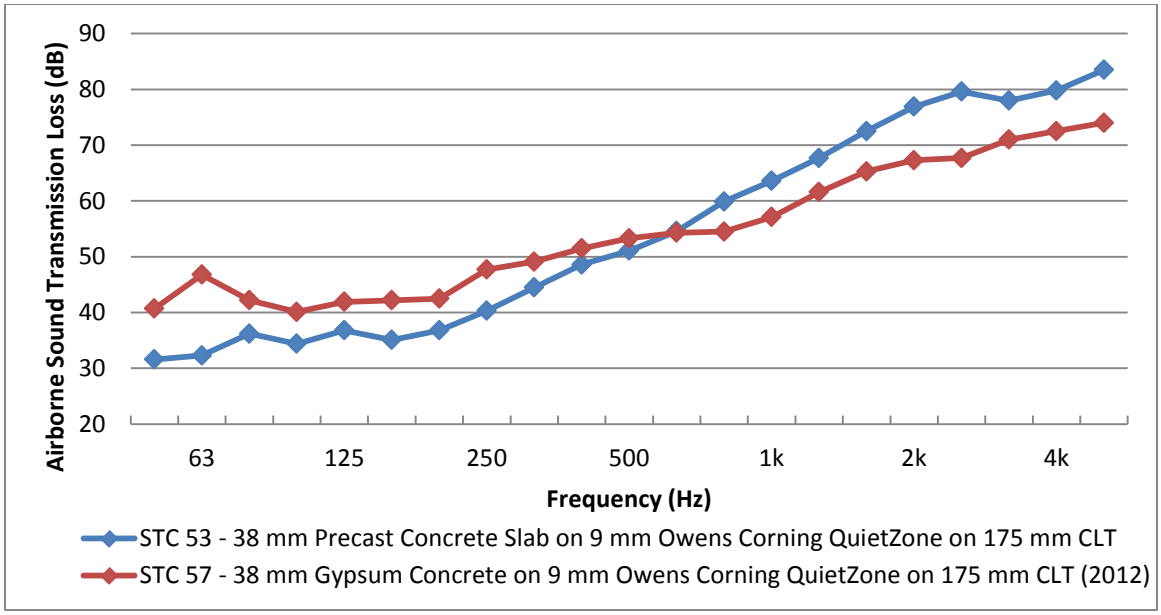


Figure 9 – Poured gypsum concrete vs. precast concrete topping (2012 tests)

8. TL Interpolation for Floor Toppings

There is no exact method or simple calculation to interpolate between various toppings, because there are several important parameters that must be taken into account, such as the dynamic stiffness of the resilient interlayer, the mass of the topping, and the bending stiffness of the topping in both directions for different base floors. If these parameters were well characterized, a model could probably be developed.

In general, adding more mass on the floor without a resilient layer is always good. Adding more mass on a resilient layer usually improves the sound insulation performance if the mass-spring-mass resonance frequency is moved out of the range of interest or else it may worsen the acoustic performance. As observed in Figure 7, increasing the topping mass from 103 kg/m^2 to 162 kg/m^2 did not improve the STC rating (increase of 14 points - STC 56 for both assemblies).

As a conservative estimate, it may be assumed that a topping of more than 38 mm thickness on a resilient membrane will have the same or better sound insulation performance as a topping of 38 mm thickness. Less conservative estimates can be based on additional comparisons and additional tests.

9. TL Improvement of Floor Coverings

In most cases, floor coverings have a beneficial effect on the sound insulation performance of a floor assembly. However, they can also have a degrading effect in some cases. The addition of a floating engineered wood floor on CLT 175 mm assemblies leads to a decrease in STC by -1 to -2 points (Figure 10). The worsening is due to the introduction of a mass-spring-mass resonance at 400 Hz which directly affects the STC rating. For the poured concrete assembly on tar board, the addition of a covering decreases the STC rating from STC 47 to STC 42 for the same reason.

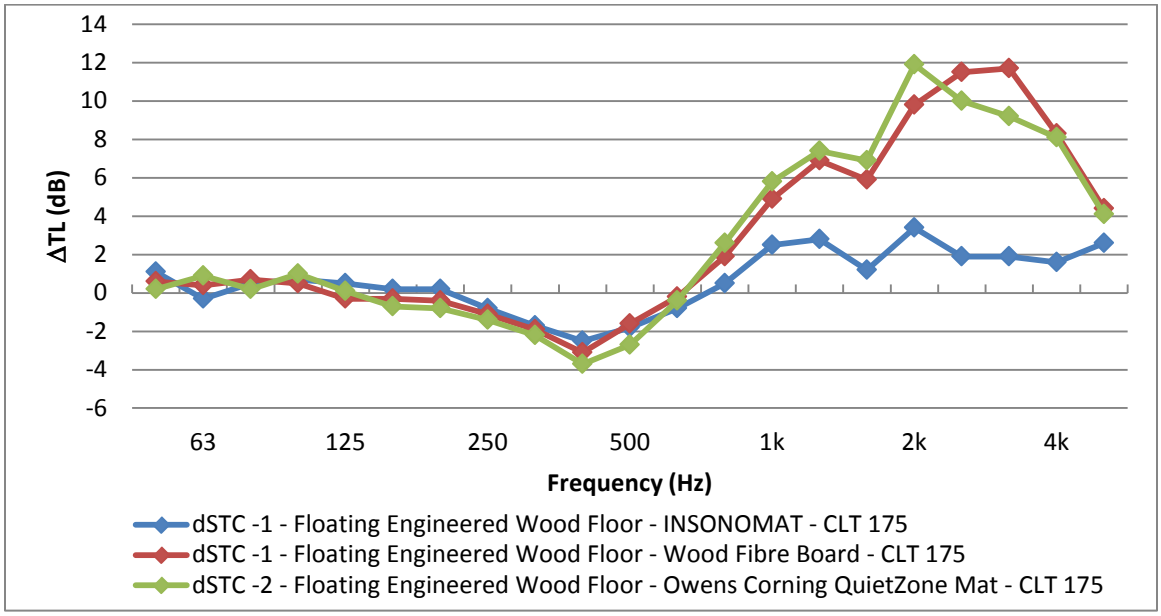


Figure 10 – Floating Engineered Wood Flooring Installed on 175 mm CLT

10. TL Improvement of Hung Ceilings

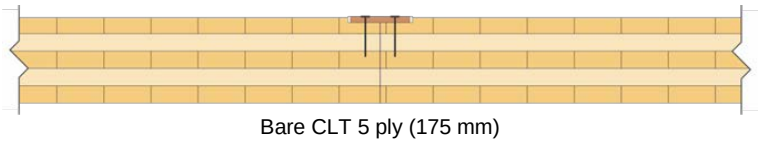
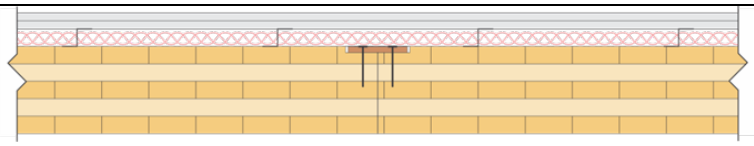
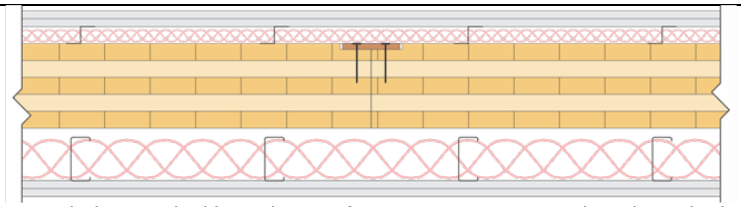
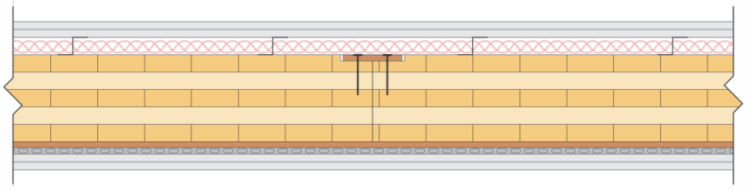
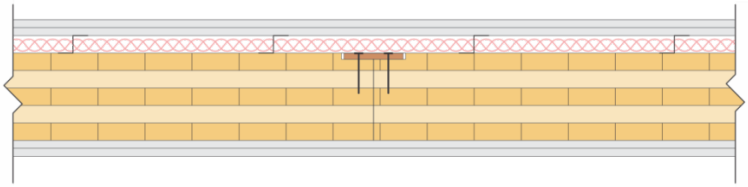
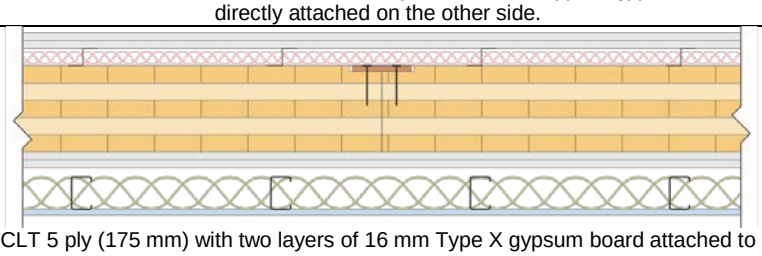
Hung ceilings are by far the most effective method to improve airborne and impact noise insulation for the floors in this study. The assemblies with a hung ceiling and a topping tested in this study achieved STC ratings between 62 and 75, and IIC ratings between 48 and 67. In areas where superior airborne or impact noise insulation is required, a hung ceiling should be used.

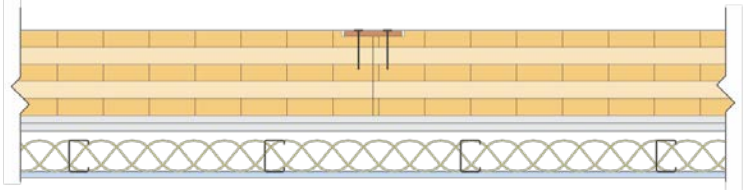
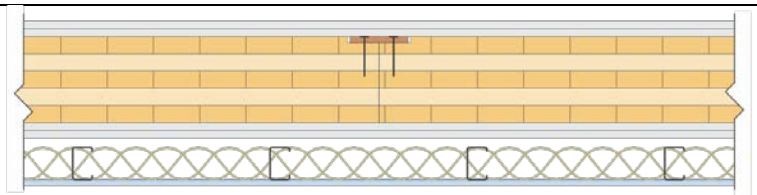
The installation of a ventilation box and flexible vent in the hung ceiling cavity was found to have no significant effect on the airborne or impact sound insulation, as long as the ventilation box was not touching the CLT floor.

11. TL Results of Glulam Floors

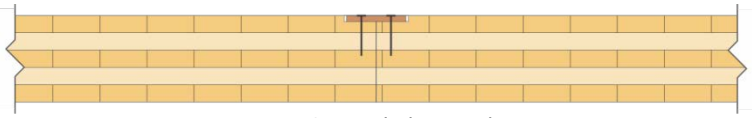
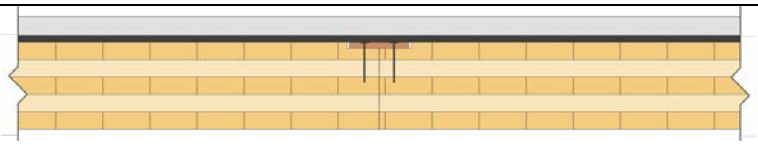
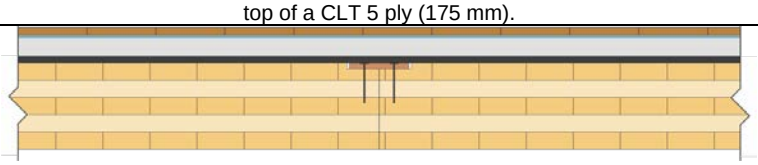
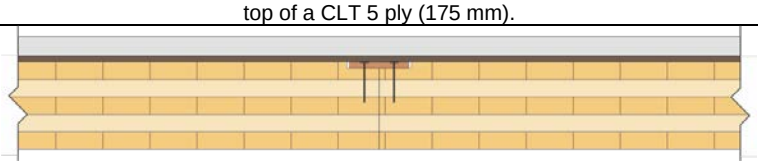
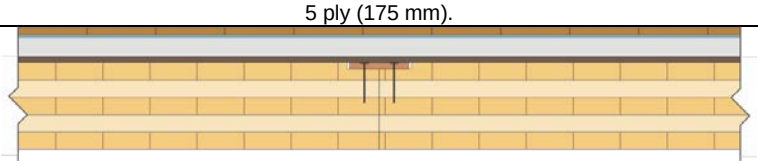
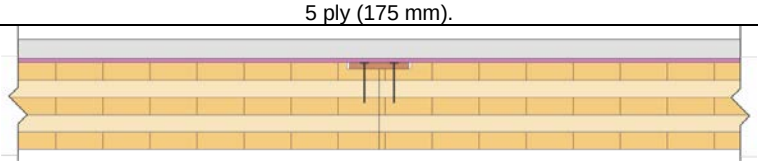
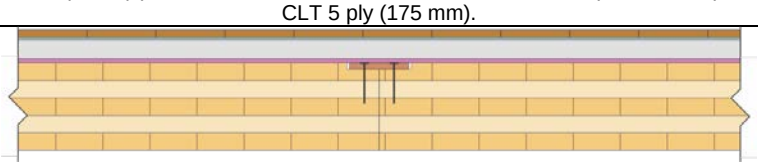
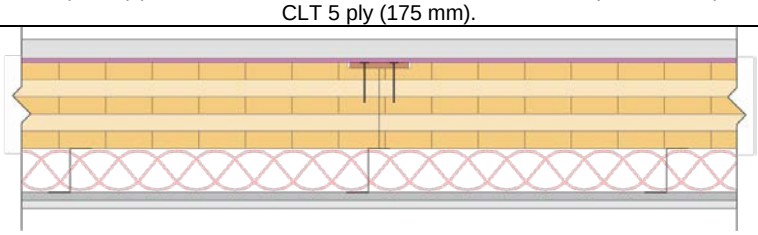
Three glulam decking floors were tested. Installing a precast concrete topping (120 kg/m^2) on the glulam assembly is sufficient to achieve the minimum STC rating of 50 in the laboratory. Adding carpet tiles on top of the heavy topping improved the IIC rating to 51. It is to note that the glulam floor decking assemblies will be installed on purlins in the field and may have slightly better or worse results based on the supporting assembly.

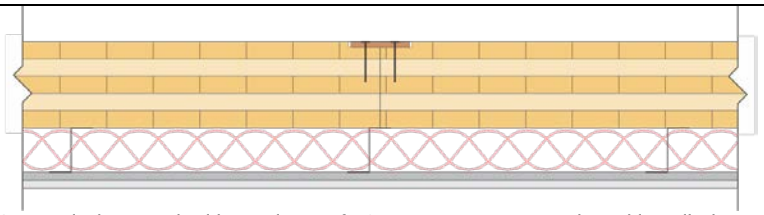
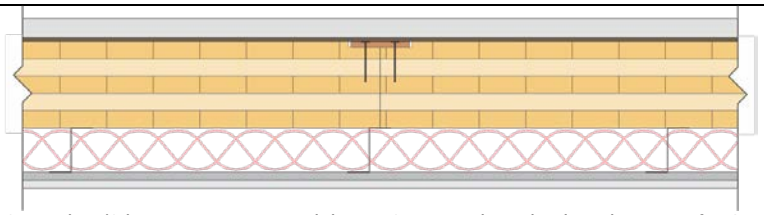
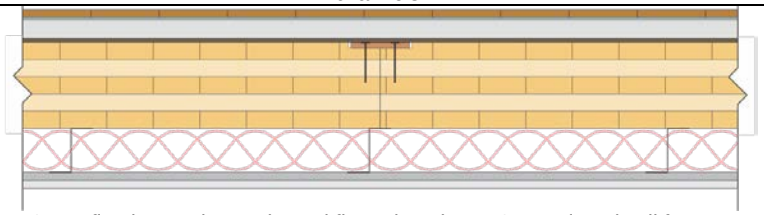
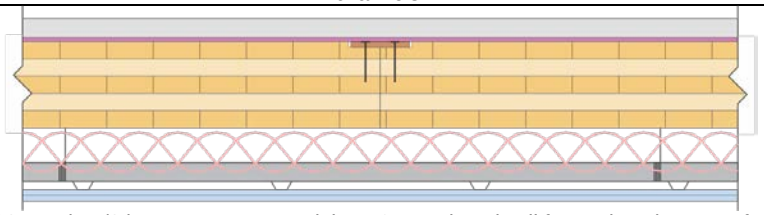
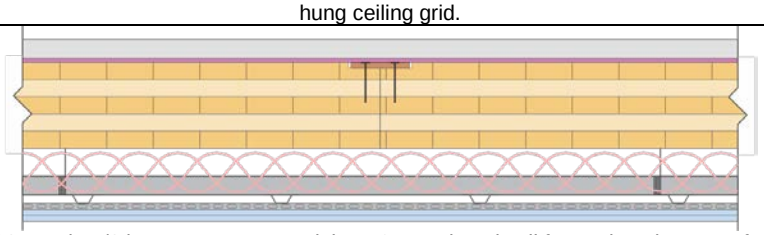
List of Wall Assemblies

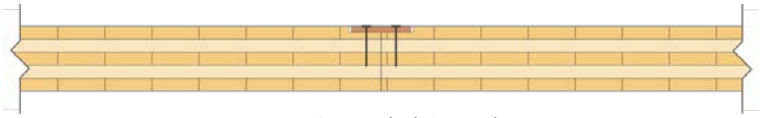
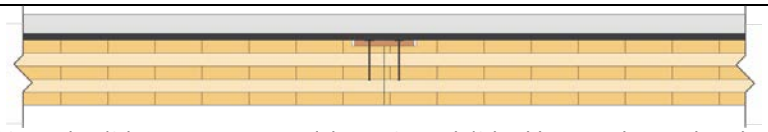
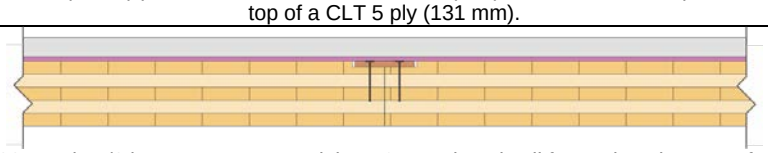
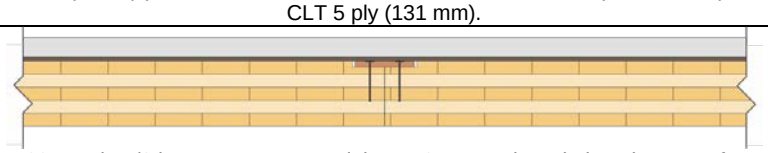
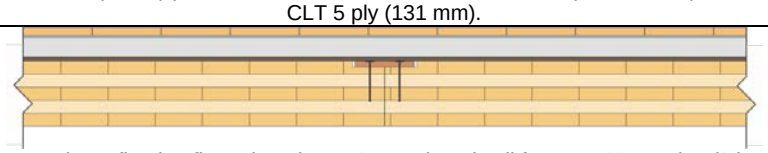
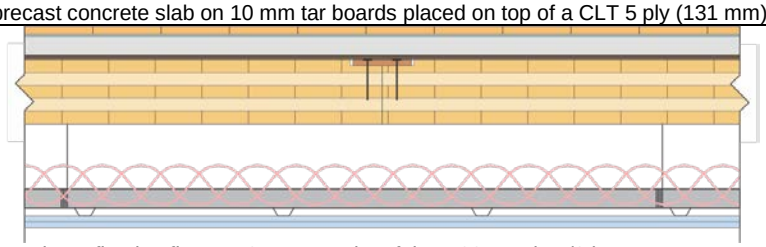
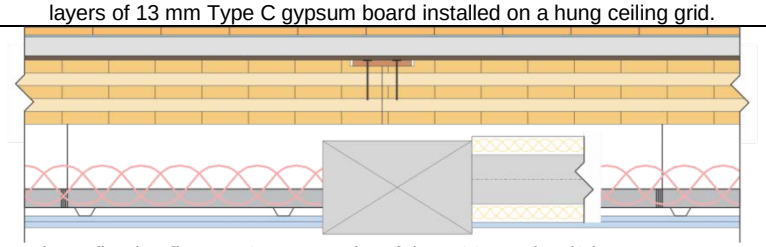
Specimen ID	Sketch and Short Description	STC Rating	Page Number
A1-006070-01W	 Bare CLT 5 ply (175 mm)	37	12
A1-006070-08W	 CLT 5 ply (175 mm) with two layers of 16 mm Type X gypsum board attached to 35 mm Z-channels on one side.	53	14
A1-006070-09W	 CLT 5 ply (175 mm) with two layers of 16 mm Type X gypsum board attached to 35 mm Z-channels on one side and two layers of 16 mm Type X gypsum board attached to a decoupled 92 mm steel stud wall on the other side.	71	16
A1-006070-10W	 CLT 5 ply (175 mm) with two layers of 16 mm Type X gypsum board attached to 35 mm Z-channels on one side and two layers of 16 mm Type X gypsum board attached to resilient channels on plywood strips on the other side.	53	19
A1-006070-11W	 CLT 5 ply (175 mm) with two layers of 16 mm Type X gypsum board attached to 35 mm Z-channels on one side and two layers of 16 mm Type X gypsum board directly attached on the other side.	53	22
A1-006070-12W	 CLT 5 ply (175 mm) with two layers of 16 mm Type X gypsum board attached to 35 mm Z-channels on one side and two layers of 16 mm Type X gypsum board directly attached on the other side of the CLT plus a decoupled steel stud wall with 13 mm Type C gypsum board.	65	25

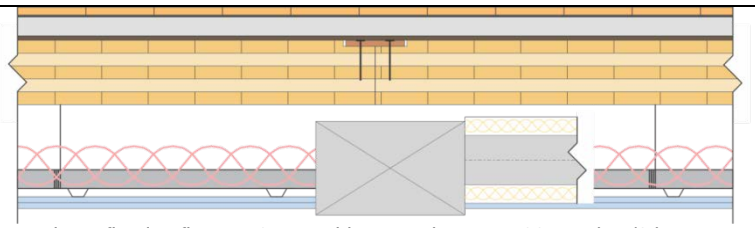
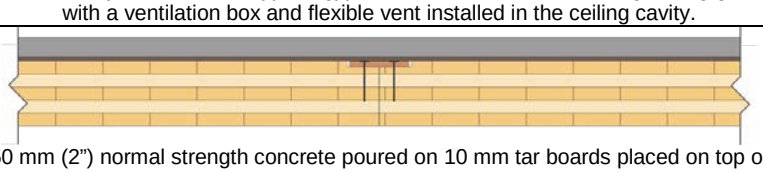
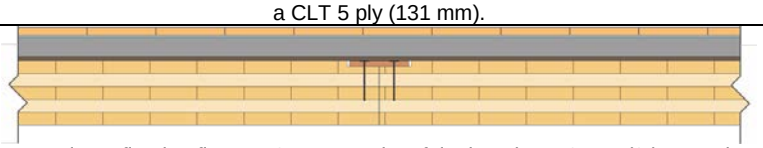
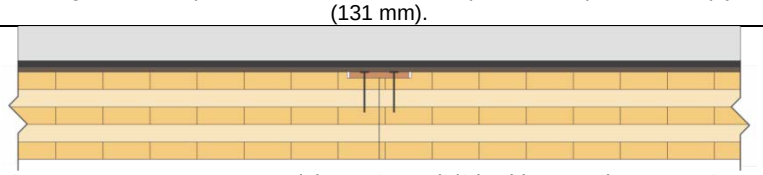
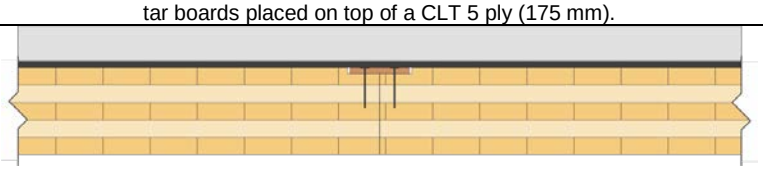
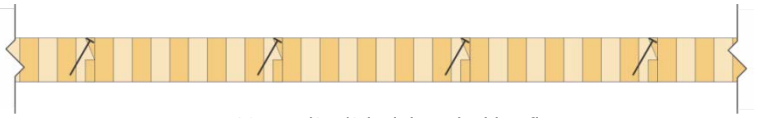
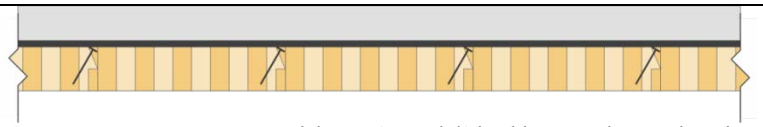
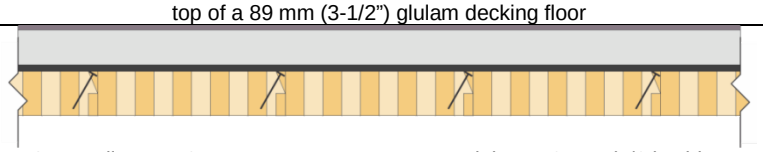
Specimen ID	Sketch and Short Description	STC Rating	Page Number
A1-006070-13W	 CLT 5 ply (175 mm) with two layers of 16 mm Type X gypsum board directly attached with a decoupled steel stud wall with 13 mm Type C gypsum board on one side.	62	28
A1-006070-14W	 CLT 5 ply (175 mm) with two layers of 16 mm Type X gypsum board directly attached to both sides with a decoupled steel stud wall with 13 mm Type C gypsum board on one side.	61	31

List of Floor Assemblies

Specimen ID	Sketch and Short Description	STC Rating	IIC Rating	Page Number
A1-006070-01F	 Bare CLT 5 ply (175 mm)	42	26	40
A1-006070-02F	 38 mm (1-1/2") precast concrete slab on 13 mm (1/2") rubber membrane placed on top of a CLT 5 ply (175 mm).	56	48	44
A1-006070-03F	 10 mm floating engineered wood floor placed on a 2 mm closed cell foam on 38 mm (1-1/2") precast concrete slab on 13 mm (1/2") rubber membrane placed on top of a CLT 5 ply (175 mm).	55	51	48
A1-006070-04F	 38 mm (1-1/2") precast concrete slab on 10 mm tar boards placed on top of a CLT 5 ply (175 mm).	54	36	52
A1-006070-05F	 10 mm floating engineered wood floor placed on a 2 mm closed cell foam on 38 mm (1-1/2") precast concrete slab on 10 mm tar boards placed on top of a CLT 5 ply (175 mm).	53	47	56
A1-006070-06F	 38 mm (1-1/2") precast concrete slab on 9 mm closed cell foam placed on top of a CLT 5 ply (175 mm).	54	39	60
A1-006070-07F	 10 mm floating engineered wood floor placed on a 2 mm closed cell foam on 38 mm (1-1/2") precast concrete slab on 9 mm closed cell foam placed on top of a CLT 5 ply (175 mm).	52	48	64
A1-006070-08F	 38 mm (1-1/2") precast concrete slab on 9 mm closed cell foam placed on top of a CLT 5 ply (175 mm) with one layer of 16 mm Type X gypsum board installed on Z channels.	70	56	68

Specimen ID	Sketch and Short Description	STC Rating	IIC Rating	Page Number
A1-006070-09F	 CLT 5 ply (175 mm) with one layer of 16 mm Type X gypsum board installed on Z channels	62	48	72
A1-006070-10F	 38 mm (1-1/2”) precast concrete slab on 10 mm tar boards placed on top of a CLT 5 ply (175 mm) with one layer of 16 mm Type X gypsum board installed on Z channels.	69	54	76
A1-006070-11F	 10 mm floating engineered wood floor placed on a 2 mm closed cell foam on 38 mm (1-1/2”) precast concrete slab on 10 mm tar boards placed on top of a CLT 5 ply (175 mm) with one layer of 16 mm Type X gypsum board installed on Z channels.	69	58	80
A1-006070-12F	 38 mm (1-1/2”) precast concrete slab on 9 mm closed cell foam placed on top of a CLT 5 ply (175 mm) with two layers of 13 mm Type C gypsum board installed on a hung ceiling grid.	72	65	84
A1-006070-13F	 38 mm (1-1/2”) precast concrete slab on 9 mm closed cell foam placed on top of a CLT 5 ply (175 mm) with two layers of 13 mm Type C gypsum board installed on a hung ceiling grid with resilient channels.	73	66	88
A1-006070-14F	 38 mm (1-1/2”) precast concrete slab on 9 mm closed cell foam placed on top of a CLT 5 ply (175 mm) with one layer of 13 mm Type C gypsum board installed on a hung ceiling grid with resilient channels	72	62	92

Specimen ID	Sketch and Short Description	STC Rating	IIC Rating	Page Number
A1-006070-20F	 Bare CLT 5 ply (131 mm)	39	22	96
A1-006070-21F	 38 mm (1-1/2”) precast concrete slab on 13 mm (1/2”) rubber membrane placed on top of a CLT 5 ply (131 mm).	53	47	100
A1-006070-22F	 38 mm (1-1/2”) precast concrete slab on 9 mm closed cell foam placed on top of a CLT 5 ply (131 mm).	52	40	104
A1-006070-23F	 38 mm (1-1/2”) precast concrete slab on 10 mm tar board placed on top of a CLT 5 ply (131 mm).	52	41	108
A1-006070-24F	 Laminate floating floor placed on a 2 mm closed cell foam on 38 mm (1-1/2”) precast concrete slab on 10 mm tar boards placed on top of a CLT 5 ply (131 mm).	50	46	112
A1-006070-25F	 Laminate floating floor on 3 mm premium felt on 38 mm (1-1/2”) precast concrete slab on 9 mm closed cell foam placed on top of a CLT 5 ply (131 mm) with two layers of 13 mm Type C gypsum board installed on a hung ceiling grid.	75	66	116
A1-006070-26F	 Laminate floating floor on 3 mm premium felt on 38 mm (1-1/2”) precast concrete slab on 9 mm closed cell foam placed on top of a CLT 5 ply (131 mm) with two layers of 13 mm Type C gypsum board installed on a hung ceiling grid with a ventilation box and flexible vent installed in the ceiling cavity.	75	65	120

Specimen ID	Sketch and Short Description	STC Rating	IIC Rating	Page Number
A1-006070-27F	 Laminate floating floor on 3 mm rubber membrane on 38 mm (1-1/2") precast concrete slab on 9 mm closed cell foam placed on top of a CLT 5 ply (131 mm) with two layers of 13 mm Type C gypsum board installed on a hung ceiling grid with a ventilation box and flexible vent installed in the ceiling cavity.	75	67	124
A1-006070-28F	 50 mm (2") normal strength concrete poured on 10 mm tar boards placed on top of a CLT 5 ply (131 mm).	47	35	128
A1-006070-29F	 Laminate floating floor on 3 mm premium felt placed on 50 mm (2") normal strength concrete poured on 10 mm tar boards placed on top of a CLT 5 ply (131 mm).	42	45	126
A1-006070-30F	 70 mm cement mortar precast slab on 13 mm (1/2") rubber membrane on 10 mm tar boards placed on top of a CLT 5 ply (175 mm).	58	47	130
A1-006070-31F	 70 mm cement mortar precast slab on 13 mm (1/2") rubber membrane placed on top of a CLT 5 ply (175 mm).	56	45	134
A1-006070-32F	 Bare 89 mm (3-1/2") glulam decking floor	33	22	138
A1-006070-33F	 70 mm cement mortar precast slab on 13 mm (1/2") rubber membrane placed on top of a 89 mm (3-1/2") glulam decking floor	51	42	142
A1-006070-34F	 Carpet tiles on 70 mm cement mortar precast slab on 13 mm (1/2") rubber membrane placed on top of a 89 mm (3-1/2") glulam decking floor	52	51	146

Client Nordic Engineered Wood
1100 Ave des Canadiens-de-Montreal
Montreal QC H3B 2S2

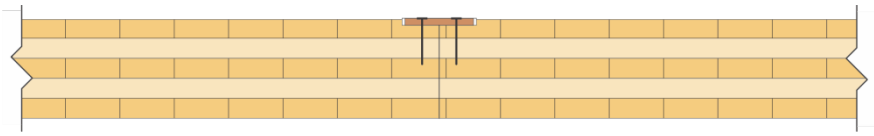
Specimen Bare CLT 5 ply (175 mm)

Specimen ID A1-006070-01W

Construction Dates: November 18, 2014 to November 19, 2014

Specimen Description

The specimen was composed of two cross-laminated timber (CLT) 5 ply (175 mm thick x 1830 mm wide x 2440 mm long) panels with a vertical butt joint in the middle of the wall. The combined panels filled the entire wall opening of the test frame. The two CLT panels were joined using a 120 mm wide x 12 mm thick plywood strip spanning the full joint (2.44 m). The plywood strip was nailed with common nails 75 mm (3") long spaced 305 mm (12") on centre along the joint with beads of PL premium adhesive between the plywood strip and the CLT panels. The CLT wall was resting on and not attached to the test frame. The air gaps between the edges of the CLT wall and the test frame were filled with glass fiber insulation and backer rod on top.



Top View of A1-006070-01W

Specimen Properties

Element	Actual thickness (mm)	Mass (kg)	Mass/length, area or volume
175 mm CLT 5-ply	175	812	91.0 kg/m^2
Total	**175**	**812**	**91 kg/m^2**

Test Specimen Installation

- The exposed area of the wall specimen used for the calculations of the airborne sound transmission loss was 8.92 m^2 (3.66 m x 2.44 m).
- The mass per area of the elements was calculated using the total area (8.92 m^2).

ASTM E90 Test Results – Airborne Sound Transmission Loss

Client: Nordic Engineered Wood **Test ID:** TLA-14-077

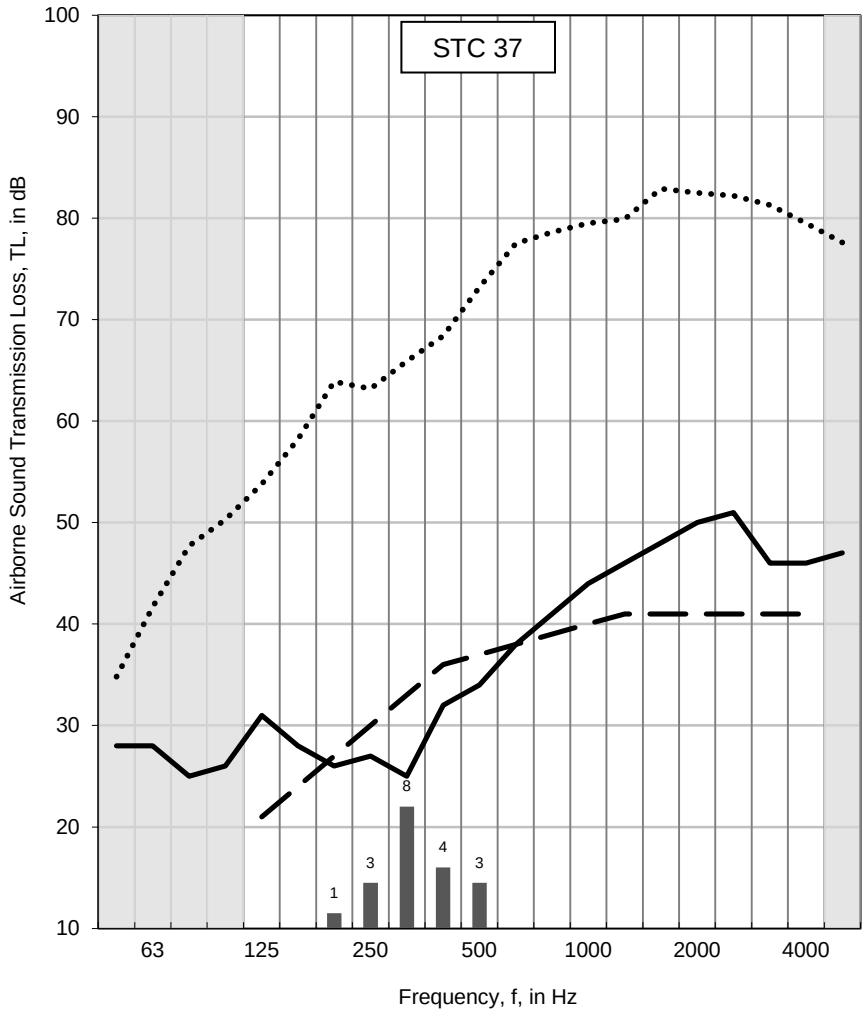
Specimen ID: A1-006070-01W **Date of Test:** November 19, 2014

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Large	255.6	18.3 to 18.3	29.4 to 33.6
Small	141.2	17.8 to 19.5	45.4 to 47.5

Area S of test specimen:	8.92 m^2
Mass per unit area:	91 kg/m^2

f (Hz)	Airborne TL 1/3-octave (dB)
50	28
63	28
80	25
100	26
125	31
160	28
200	26
250	27
315	25
400	32
500	34
630	38
800	41
1000	44
1250	46
1600	48
2000	50
2500	51
3150	46
4000	46
5000	47
Sound Transmission Class (STC)	**37**

Sum of Deficiencies (dB)
19
Max. Deficiency (dB)
8 dB at 315 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Airborne sound transmission loss measurements were conducted in accordance with the requirements of ASTM E90-09, "Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements" with the exception that the humidity in the large room fell below 30% and the humidity variation was above 3%.**

In the graph:
The solid line is the measured sound transmission loss for this specimen. The dashed line is the STC contour fitted to the measured values according to ASTM E413-10. The dotted line (may be above the displayed range) is 10 dB below the flanking limit established for this facility. For any frequency band where the measured transmission loss is above the dotted line, the reported value is potentially limited by flanking transmission via laboratory surfaces, and the true value may be higher than that measured. Bars at the bottom of the graph show deficiencies where the measured data are less than the reference contour as described in the fitting procedure for the STC, defined in ASTM E413-10. The shaded cells in the table and areas in the graph are outside the STC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. The reported values have been corrected according to the procedure outlined in ASTM E90-09. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level, in which case, the corrected values provide an estimate of the lower limit of airborne sound transmission loss.

Client Nordic Engineered Wood
1100 Ave des Canadiens-de-Montreal
Montreal QC H3B 2S2

Specimen CLT 5 ply (175 mm) with two layers of 16 mm Type X gypsum board attached to 35 mm Z-channels on one side

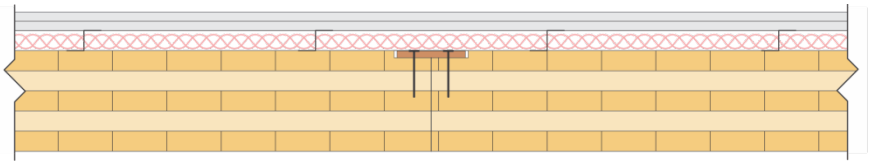
Specimen ID A1-006070-08W

Construction Dates: December 2, 2014 to December 3, 2014

Specimen Description

The specimen was composed of two cross-laminated timber (CLT) 5 ply (175 mm thick x 1830 mm wide x 2440 mm long) panels with a vertical butt joint in the middle of the wall. The combined panels filled the entire wall opening of the test frame. The two CLT panels were joined using a 120 mm wide x 12 mm thick plywood strip spanning the full joint (2.44 m). The plywood strip was nailed with common nails 75 mm (3") long spaced 305 mm (12") on centre along the joint with beads of PL premium between the plywood strip and the CLT panels. The CLT wall was resting on and not attached to the test frame. The air gaps between the edges of the CLT wall and the test frame were filled with glass fiber insulation and backer rod on top.

On one side of the CLT wall (large chamber side), two layers of 16 mm (5/8") Type X gypsum board were installed on 35 mm Z-channels (26 ga). The Z-channels were attached vertically to the CLT wall at a spacing of 406 mm (16") on centre with 38 mm (1-1/2") Owens Corning EcoTouch Fiberglas® Batts in the cavity. The base layer of gypsum board was attached with their long side vertical using 32 mm (1-1/4") long type S screws spaced 305 mm (12") on centre on every Z-channel. The face layer were installed with their long side vertical and staggered from the base layer using 50 mm (2") type S screws spaced 305 mm (12") on centre on every Z-channel. The exposed joints were caulked and taped.



Top View of A1-006070-08W

Specimen Properties

Element	Actual thickness (mm)	Mass (kg)	Mass/length, area or volume
175 mm CLT 5-ply	175	812	91.0 kg/m^2
38 mm OC EcoTouch Pink Fiberglas® Batts	38*	5	0.6 kg/m^2
35 mm Z-channels (26 ga)	35	9	0.6 kg/m
16 mm Type X Gypsum Board	16	98	11.0 kg/m^2
16 mm Type X Gypsum Board	16	98	11.0 kg/m^2
Total	**242**	**1022**	**115 kg/m^2**

***** The thickness of the insulation batts is not included in the total specimen thickness.

Test Specimen Installation

- The exposed area of the wall specimen used for the calculations of the airborne sound transmission loss was 8.92 m^2 (3.66 m x 2.44 m).
- The mass per area of the elements was calculated using the total area (8.92 m^2).

ASTM E90 Test Results – Airborne Sound Transmission Loss

Client: Nordic Engineered Wood **Test ID:** TLA-14-086

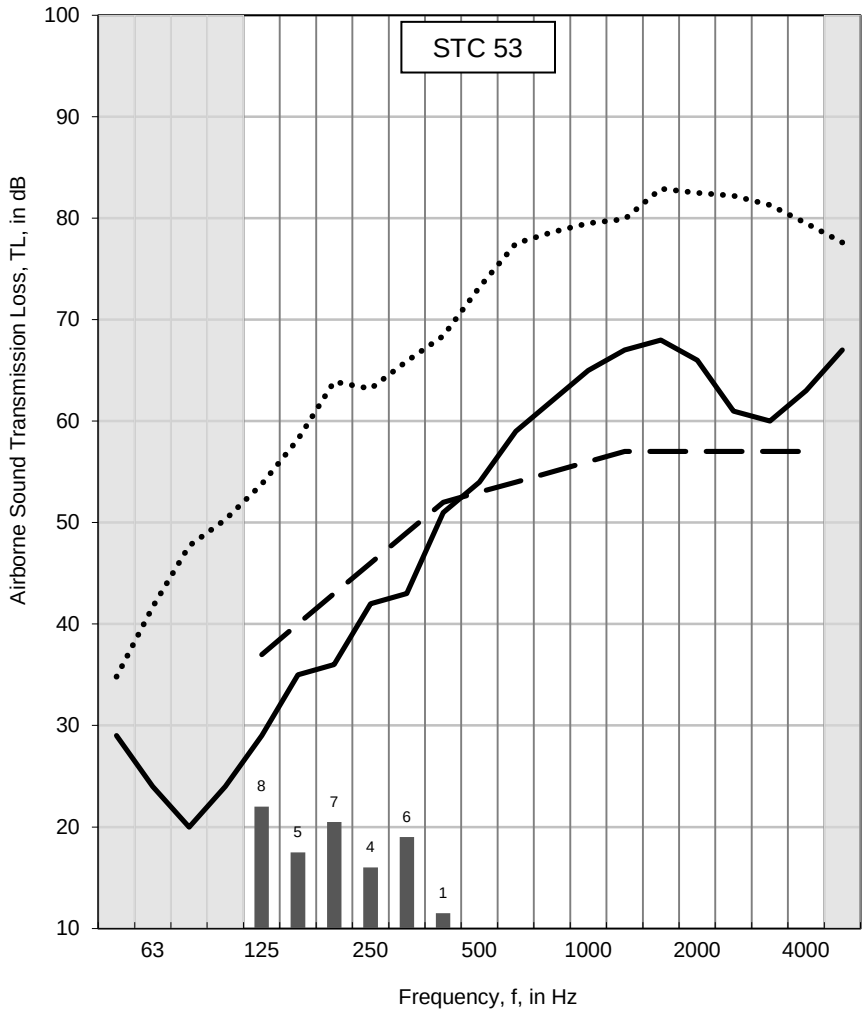
Specimen ID: A1-006070-08W **Date of Test:** December 4, 2014

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Large	255.0	18.7 to 18.8	26.4 to 31.5
Small	141.2	17.1 to 17.2	43.0 to 43.7

Area S of test specimen:	8.92 m^2
Mass per unit area:	115 kg/m^2

f (Hz)	Airborne TL 1/3-octave (dB)
50	29
63	24
80	20
100	24
125	29
160	35
200	36
250	42
315	43
400	51
500	54
630	59
800	62
1000	65
1250	67
1600	68
2000	66
2500	61
3150	60
4000	63
5000	67
Sound Transmission Class (STC)	**53**

Sum of Deficiencies (dB)
31
Max. Deficiency (dB)
8 dB at 125 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Airborne sound transmission loss measurements were conducted in accordance with the requirements of ASTM E90-09, "Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements" with the exception that the humidity in the large room fell below 30% and the humidity variation was above 3%.**

In the graph:
The solid line is the measured sound transmission loss for this specimen. The dashed line is the STC contour fitted to the measured values according to ASTM E413-10. The dotted line (may be above the displayed range) is 10 dB below the flanking limit established for this facility. For any frequency band where the measured transmission loss is above the dotted line, the reported value is potentially limited by flanking transmission via laboratory surfaces, and the true value may be higher than that measured. Bars at the bottom of the graph show deficiencies where the measured data are less than the reference contour as described in the fitting procedure for the STC, defined in ASTM E413-10. The shaded cells in the table and areas in the graph are outside the STC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. The reported values have been corrected according to the procedure outlined in ASTM E90-09. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level, in which case, the corrected values provide an estimate of the lower limit of airborne sound transmission loss.

Client Nordic Engineered Wood
1100 Ave des Canadiens-de-Montreal
Montreal QC H3B 2S2

Specimen ***PAL détail 8***

CLT 5 ply (175 mm) with two layers of 16 mm Type X gypsum board attached to 35 mm Z-channels on one side and two layers of 16 mm Type X gypsum board attached to a decoupled 92 mm steel stud wall on the other side.

Specimen ID A1-006070-09W

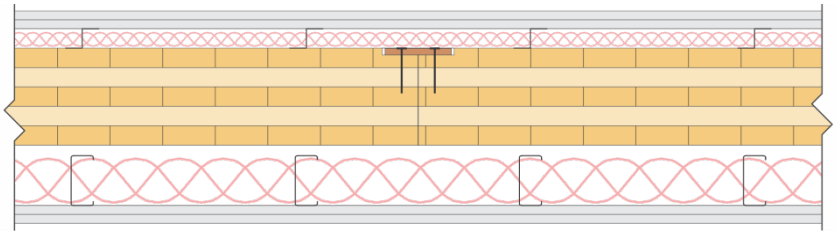
Construction Dates: December 4, 2014 to December 5, 2014

Specimen Description

The specimen was composed of two cross-laminated timber (CLT) 5 ply (175 mm thick x 1830 mm wide x 2440 mm long) panels with a vertical butt joint in the middle of the wall. The combined panels filled the entire wall opening of the test frame. The two CLT panels were joined using a 120 mm wide x 12 mm thick plywood strip spanning the full joint (2.44 m). The plywood strip was nailed with common nails 75 mm (3") long spaced 305 mm (12") on centre along the joint with beads of PL premium adhesive between the plywood strip and the CLT panels. The CLT wall was resting on and not attached to the test frame. The air gaps between the edges of the CLT wall and the test frame were filled with glass fiber insulation and backer rod on top.

On one side of the CLT wall (large chamber side), two layers of 16 mm (5/8") Type X gypsum board were installed on 35 mm Z-channels (26 Ga). The Z-channels were attached vertically to the CLT wall at a spacing of 406 mm (16") on centre with 38 mm (1-1/2") Owens Corning EcoTouch Fiberglas® Batts in the cavity. The base layer of gypsum board was attached with their long side vertical using 32 mm (1-1/4") long type S screws spaced 305 mm (12") on centre on every Z-channel. The face layer were installed with their long side vertical and staggered from the base layer using 50 mm (2") type S screws spaced 305 mm (12") on centre on every Z-channel. The exposed joints were caulked and taped.

On the other side of the CLT wall (small chamber side), two layers of 16 mm (5/8") Type X gypsum board were installed on decoupled 92 mm (3-5/8") lightweight steel studs. The steel studs were installed 19 mm (3/4") in front of the CLT wall with a spacing of 406 mm (16") on centre with 92 mm (3-5/8") Owens Corning EcoTouch Fiberglas® Batts in the cavity. The base layer of gypsum board was attached with their long side vertical using 32 mm (1-1/4") long type S screws spaced 305 mm (12") on centre on every stud. The face layer were installed with their long side vertical and staggered from the base layer using 50 mm (2") type S screws spaced 305 mm (12") on centre on every stud. The exposed joints were caulked and taped.



Top View of A1-006070-09W

Specimen Properties

Element	Actual thickness (mm)	Mass (kg)	Mass/length, area or volume
16 mm Type X Gypsum Board	16	98	11.0 kg/m^2
16 mm Type X Gypsum Board	16	98	11.0 kg/m^2
92 mm OC EcoTouch Pink Fiberglas® Batts	92*	13	1.5 kg/m^2
92 mm Steel Studs (26 ga)	92	13	0.5 kg/m
19 mm Air Gap	19	-	- -
175 mm CLT 5-ply	175	812	91.0 kg/m^2
38 mm OC EcoTouch Pink Fiberglas® Batts	38*	5	0.6 kg/m^2
35 mm Z-channels (26 ga)	35	9	0.4 kg/m
16 mm Type X Gypsum Board	16	98	11.0 kg/m^2
16 mm Type X Gypsum Board	16	98	11.0 kg/m^2
Total	**385**	**1244**	**140 kg/m^2**

***** The thicknesses of the insulation batts are not included in the total specimen thickness.

Test Specimen Installation

- The exposed area of the wall specimen used for the calculations of the airborne sound transmission loss was 8.92 m^2 (3.66 m x 2.44 m).
- The mass per area of the elements was calculated using the total area (8.92 m^2).

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ASTM E90 Test Results – Airborne Sound Transmission Loss

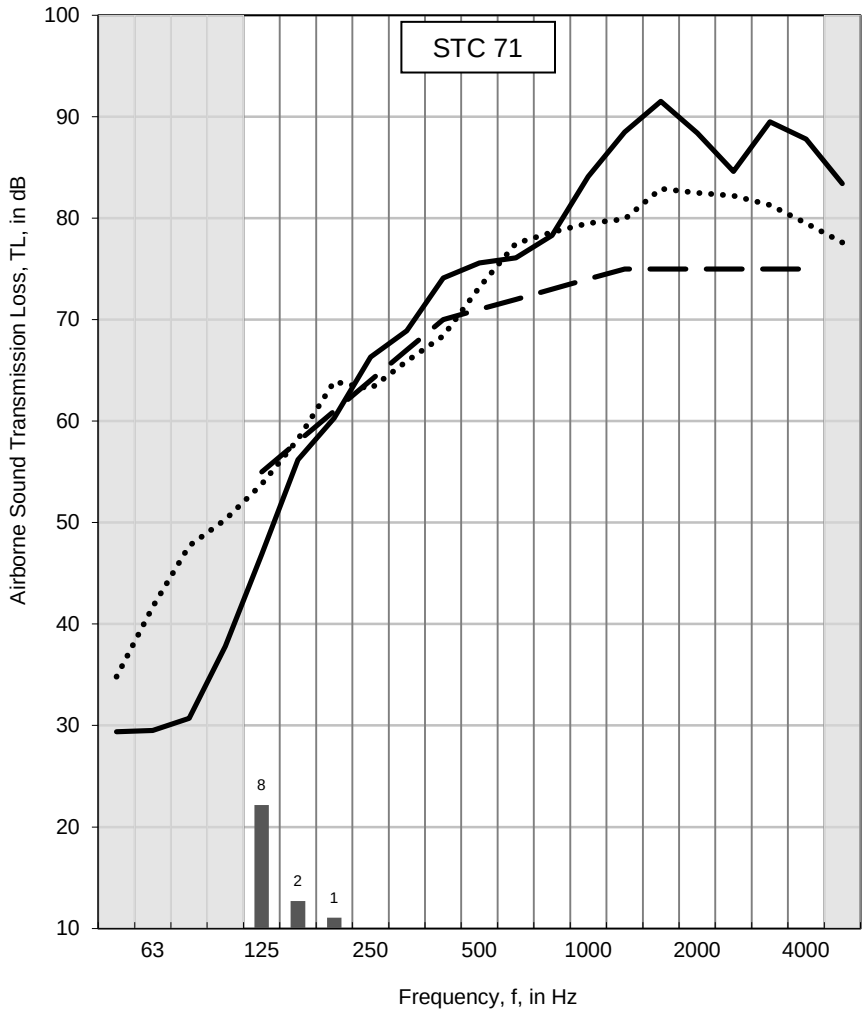
Client: Nordic Engineered Wood **Test ID:** TLA-14-087

Specimen ID: A1-006070-09W **Date of Test:** December 5, 2014

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Large	255.0	19.2 to 19.2	34.2 to 37.7
Small	139.8	18.4 to 18.7	38.6 to 40.9

Area S of test specimen:	8.92 m^2
Mass per unit area:	140 kg/m^2

f (Hz)	Airborne TL 1/3-octave (dB)	
50	29	c
63	30	
80	31	
100	38	
125	47	
160	56	
200	60	
250	66	
315	69	
400	74	c
500	76	
630	76	
800	78	
1000	84	c
1250	88	*
1600	92	*
2000	88	*
2500	85	c
3150	90	*
4000	88	*
5000	83	*
Sound Transmission Class (STC)	**71**	



Sum of Deficiencies (dB)
11
Max. Deficiency (dB)
8 dB at 125 Hz

For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Airborne sound transmission loss measurements were conducted in accordance with the requirements of ASTM E90-09, "Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements" with the exception that the humidity variation in the large room was above 3%.**

In the graph:
The solid line is the measured sound transmission loss for this specimen. The dashed line is the STC contour fitted to the measured values according to ASTM E413-10. The dotted line (may be above the displayed range) is 10 dB below the flanking limit established for this facility. For any frequency band where the measured transmission loss is above the dotted line, the reported value is potentially limited by flanking transmission via laboratory surfaces, and the true value may be higher than that measured. Bars at the bottom of the graph show deficiencies where the measured data are less than the reference contour as described in the fitting procedure for the STC, defined in ASTM E413-10. The shaded cells in the table and areas in the graph are outside the STC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. The reported values have been corrected according to the procedure outlined in ASTM E90-09. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level, in which case, the corrected values provide an estimate of the lower limit of airborne sound transmission loss.

Client Nordic Engineered Wood
1100 Ave des Canadiens-de-Montreal
Montreal QC H3B 2S2

Specimen ***PAL détail 10***

CLT 5 ply (175 mm) with two layers of 16 mm Type X gypsum board attached to 35 mm Z-channels on one side and two layers of 16 mm Type X gypsum board attached to resilient channels on plywood strips on the other side.

Specimen ID A1-006070-10W

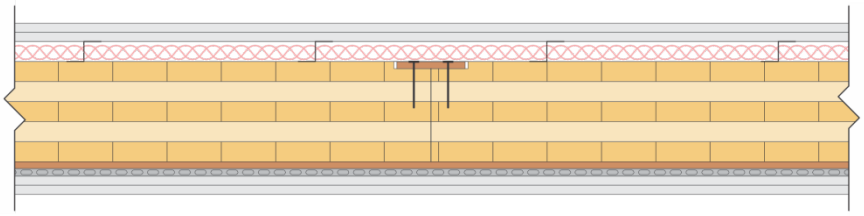
Construction Date: December 8, 2014

Specimen Description

The specimen was composed of two cross-laminated timber (CLT) 5 ply (175 mm thick x 1830 mm wide x 2440 mm long) panels with a vertical butt joint in the middle of the wall. The combined panels filled the entire wall opening of the test frame. The two CLT panels were joined using a 120 mm wide x 12 mm thick plywood strip spanning the full joint (2.44 m). The plywood strip was nailed with common nails 75 mm (3”) long spaced 305 mm (12”) on centre along the joint with beads of PL premium adhesive between the plywood strip and the CLT panels. The CLT wall was resting on and not attached to the test frame. The air gaps between the edges of the CLT wall and the test frame were filled with glass fiber insulation and backer rod on top.

On one side of the CLT wall (large chamber side), two layers of 16 mm (5/8”) Type X gypsum board were installed on 35 mm Z-channels (26 Ga). The Z-channels were attached vertically to the CLT wall at a spacing of 406 mm (16”) on centre with 38 mm (1-1/2”) Owens Corning EcoTouch Fiberglas® Batts in the cavity. The base layer of gypsum board was attached with their long side vertical using 32 mm (1-1/4") long type S screws spaced 305 mm (12”) on centre on every Z-channel. The face layer were installed with their long side vertical and staggered from the base layer using 50 mm (2") type S screws spaced 305 mm (12”) on centre on every Z-channel. The exposed joints were caulked and taped.

On the other side of the CLT wall (small chamber side), two layers of 16 mm (5/8”) Type X gypsum board were installed on resilient channels. The resilient channels were installed with a spacing of 406 mm (16”) on centre on 12 mm thick plywood strips creating an air gap of 25 mm (1”) between the CLT and the base gypsum board layer. The base layer of gypsum board was attached with their long side vertical using 32 mm (1-1/4") long type S screws spaced 305 mm (12”) on centre on every resilient channel. The face layer were installed with their long side vertical and staggered from the base layer using 50 mm (2") type S screws spaced 305 mm (12”) on centre on every resilient channel. The exposed joints were caulked and taped.



Top View of A1-006070-10W

Specimen Properties

Element	Actual thickness (mm)	Mass (kg)	Mass/length, area or volume
16 mm Type X Gypsum Board	16	98	11.0 kg/m^2
16 mm Type X Gypsum Board	16	98	11.0 kg/m^2
13 mm Resilient Channels	13	6	0.3 kg/m
12 mm Plywood Strips	12	7	0.3 kg/m
175 mm CLT 5-ply	175	812	91.0 kg/m^2
38 mm OC EcoTouch Pink Fiberglas® Batts	38*	5	0.6 kg/m^2
35 mm Z-channels (26 ga)	35	9	0.4 kg/m
16 mm Type X Gypsum Board	16	98	11.0 kg/m^2
16 mm Type X Gypsum Board	16	98	11.0 kg/m^2
Total	**299**	**1231**	**138 kg/m^2**

***** The thickness of the insulation batts is not included in the total specimen thickness.

Test Specimen Installation

- The exposed area of the wall specimen used for the calculations of the airborne sound transmission loss was 8.92 m^2 (3.66 m x 2.44 m).
- The mass per area of the elements was calculated using the total area (8.92 m^2).

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ASTM E90 Test Results – Airborne Sound Transmission Loss

Client: Nordic Engineered Wood **Test ID:** TLA-14-088

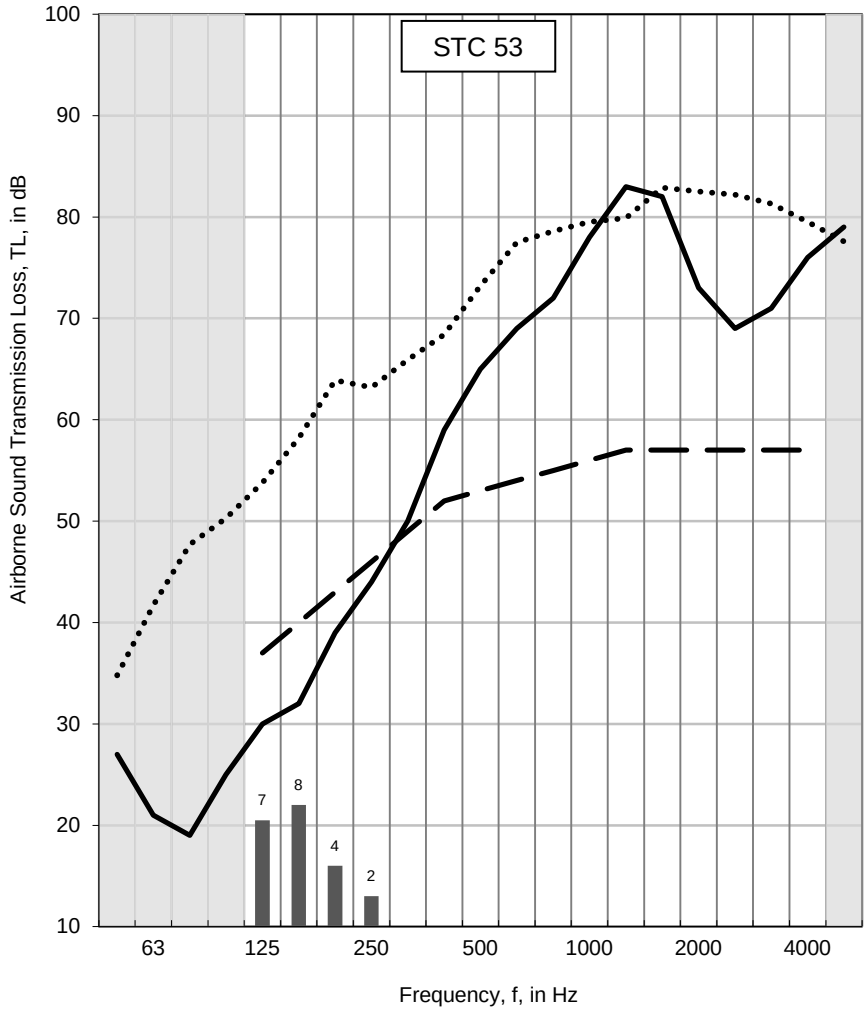
Specimen ID: A1-006070-10W **Date of Test:** December 8, 2014

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Large	255.0	20.3 to 20.4	32.0 to 35.1
Small	139.8	18.5 to 19.0	38.3 to 43.0

Area S of test specimen:	8.92 m^2
Mass per unit area:	138 kg/m^2

f (Hz)	Airborne TL 1/3-octave (dB)	
50	27	c
63	21	
80	19	
100	25	
125	30	
160	32	
200	39	
250	44	
315	50	
400	59	
500	65	
630	69	
800	72	
1000	78	
1250	83	c
1600	82	c
2000	73	
2500	69	
3150	71	
4000	76	
5000	79	c
Sound Transmission Class (STC)	**53**	

Sum of Deficiencies (dB)
21
Max. Deficiency (dB)
8 dB at 160 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Airborne sound transmission loss measurements were conducted in accordance with the requirements of ASTM E90-09, "Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements" with the exception that the humidity variation in the large room was above 3% and the humidity variation in the small room was above 3%.**

In the graph:
The solid line is the measured sound transmission loss for this specimen. The dashed line is the STC contour fitted to the measured values according to ASTM E413-10. The dotted line (may be above the displayed range) is 10 dB below the flanking limit established for this facility. For any frequency band where the measured transmission loss is above the dotted line, the reported value is potentially limited by flanking transmission via laboratory surfaces, and the true value may be higher than that measured. Bars at the bottom of the graph show deficiencies where the measured data are less than the reference contour as described in the fitting procedure for the STC, defined in ASTM E413-10. The shaded cells in the table and areas in the graph are outside the STC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. The reported values have been corrected according to the procedure outlined in ASTM E90-09. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level, in which case, the corrected values provide an estimate of the lower limit of airborne sound transmission loss.

Client Nordic Engineered Wood
1100 Ave des Canadiens-de-Montreal
Montreal QC H3B 2S2

Specimen ***PAL détail 10 (No RC)***

CLT 5 ply (175 mm) with two layers of 16 mm Type X gypsum board attached to 35 mm Z-channels on one side and two layers of 16 mm Type X gypsum board directly attached on the other side.

Specimen ID A1-006070-11W

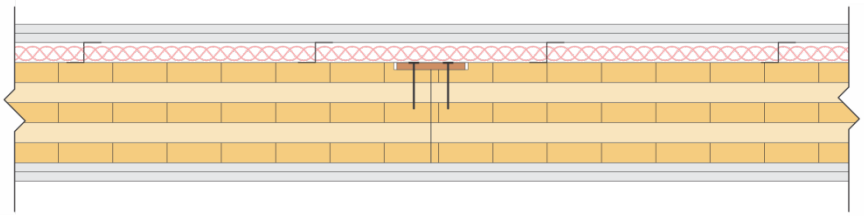
Construction Date: December 9, 2014

Specimen Description

The specimen was composed of two cross-laminated timber (CLT) 5 ply (175 mm thick x 1830 mm wide x 2440 mm long) panels with a vertical butt joint in the middle of the wall. The combined panels filled the entire wall opening of the test frame. The two CLT panels were joined using a 120 mm wide x 12 mm thick plywood strip spanning the full joint (2.44 m). The plywood strip was nailed with common nails 75 mm (3”) long spaced 305 mm (12”) on centre along the joint with beads of PL premium adhesive between the plywood strip and the CLT panels. The CLT wall was resting on and not attached to the test frame. The air gaps between the edges of the CLT wall and the test frame were filled with glass fiber insulation and backer rod on top.

On one side of the CLT wall (large chamber side), two layers of 16 mm (5/8”) Type X gypsum board were installed on 35 mm Z-channels (26 Ga). The Z-channels were attached vertically to the CLT wall at a spacing of 406 mm (16”) on centre with 38 mm (1-1/2”) Owens Corning EcoTouch Fiberglas® Batts in the cavity. The base layer of gypsum board was attached with their long side vertical using 32 mm (1-1/4") long type S screws spaced 305 mm (12”) on centre on every Z-channel. The face layer were installed with their long side vertical and staggered from the base layer using 50 mm (2") type S screws spaced 305 mm (12”) on centre on every Z-channel. The exposed joints were caulked and taped.

On the other side of the CLT wall (small chamber side), two layers of 16 mm (5/8”) Type X gypsum board were directly attached to the CLT wall. The base layer of gypsum board was attached with their long side vertical using 32 mm (1-1/4") long type S screws spaced 305 mm (12”) on centre. The face layer were installed with their long side vertical and staggered from the base layer using 50 mm (2") type S screws spaced 305 mm (12”) on centre. The exposed joints were caulked and taped.



Top View of A1-006070-11W

Specimen Properties

Element	Actual thickness (mm)	Mass (kg)	Mass/length, area or volume
16 mm Type X Gypsum Board	16	98	11.0 kg/m^2
16 mm Type X Gypsum Board	16	98	11.0 kg/m^2
175 mm CLT 5-ply	175	812	91 kg/m^2
38 mm OC EcoTouch Pink Glass Fibre Batts	38*	5	0.6 kg/m^2
35 mm Z-channels (26 ga)	35	9	0.4 kg/m
16 mm Type X Gypsum Board	16	98	11.0 kg/m^2
16 mm Type X Gypsum Board	16	98	11.0 kg/m^2
Total	**274**	**1218**	**137 kg/m^2**

***** The thickness of the insulation batts is not included in the total specimen thickness.

Test Specimen Installation

- The exposed area of the floor specimen used for the calculations of the airborne sound transmission loss was 8.92 m^2 (3.66 m x 2.44 m).
- The mass per area of the elements was calculated using the total area (8.92 m^2).

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ASTM E90 Test Results – Airborne Sound Transmission Loss

Client: Nordic Engineered Wood **Test ID:** TLA-14-089

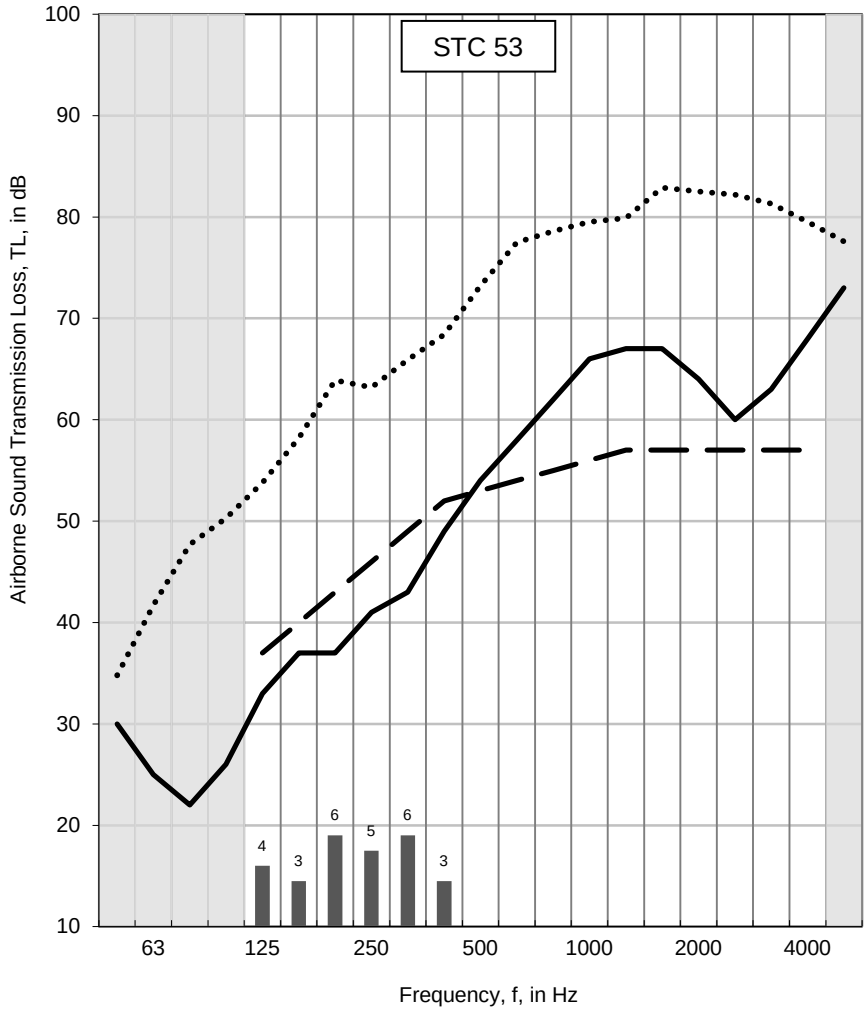
Specimen ID: A1-006070-11W **Date of Test:** December 12, 2014

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Large	255.0	20.3 to 20.3	34.6 to 37.0
Small	140.8	19.0 to 19.6	38.1 to 40.5

Area S of test specimen:	8.92 m^2
Mass per unit area:	137 kg/m^2

f (Hz)	Airborne TL 1/3-octave (dB)
50	30 c
63	25
80	22
100	26
125	33
160	37
200	37
250	41
315	43
400	49
500	54
630	58
800	62
1000	66
1250	67
1600	67
2000	64
2500	60
3150	63
4000	68
5000	73
Sound Transmission Class (STC)	**53**

Sum of Deficiencies (dB)
27
Max. Deficiency (dB)
6 dB at 200 and 315 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Airborne sound transmission loss measurements were conducted in accordance with the requirements of ASTM E90-09, "Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements".**

In the graph:
The solid line is the measured sound transmission loss for this specimen. The dashed line is the STC contour fitted to the measured values according to ASTM E413-10. The dotted line (may be above the displayed range) is 10 dB below the flanking limit established for this facility. For any frequency band where the measured transmission loss is above the dotted line, the reported value is potentially limited by flanking transmission via laboratory surfaces, and the true value may be higher than that measured. Bars at the bottom of the graph show deficiencies where the measured data are less than the reference contour as described in the fitting procedure for the STC, defined in ASTM E413-10. The shaded cells in the table and areas in the graph are outside the STC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. The reported values have been corrected according to the procedure outlined in ASTM E90-09. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level, in which case, the corrected values provide an estimate of the lower limit of airborne sound transmission loss.

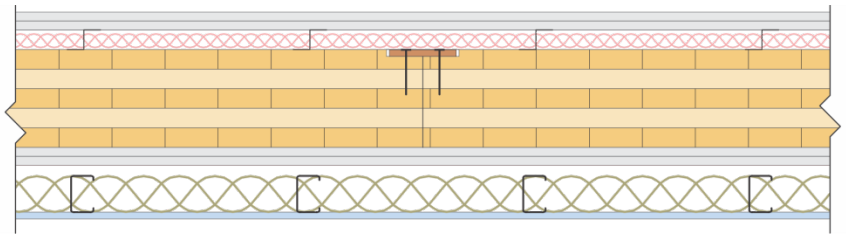
Client	Nordic Engineered Wood 1100 Ave des Canadiens-de-Montreal Montreal QC H3B 2S2
Specimen	CLT 5 ply (175 mm) with two layers of 16 mm Type X gypsum board attached to 35 mm Z-channels on one side and two layers of 16 mm Type X gypsum board directly attached on the other side of the CLT plus a decoupled steel stud wall with 13 mm Type C gypsum board.
Specimen ID	A1-006070-12W
Construction Dates:	December 9, 2014 to December 10, 2014

Specimen Description

The specimen was composed of two cross-laminated timber (CLT) 5 ply (175 mm thick x 1830 mm wide x 2440 mm long) panels with a vertical butt joint in the middle of the wall. The combined panels filled the entire wall opening of the test frame. The two CLT panels were joined using a 120 mm wide x 12 mm thick plywood strip spanning the full joint (2.44 m). The plywood strip was nailed with common nails 75 mm (3”) long spaced 305 mm (12”) on centre along the joint with beads of PL premium adhesive between the plywood strip and the CLT panels. The CLT wall was resting on and not attached to the test frame. The air gaps between the edges of the CLT wall and the test frame were filled with glass fiber insulation and backer rod on top.

On one side of the CLT wall (large chamber side), two layers of 16 mm (5/8”) Type X gypsum board were installed on 35 mm Z-channels (26 Ga). The Z-channels were attached vertically to the CLT wall at a spacing of 406 mm (16”) on centre with 38 mm (1-1/2”) Owens Corning EcoTouch Fiberglas® Batts in the cavity. The base layer of gypsum board was attached with their long side vertical using 32 mm (1-1/4") long type S screws spaced 305 mm (12”) on centre on every Z-channel. The face layer were installed with their long side vertical and staggered from the base layer using 50 mm (2") type S screws spaced 305 mm (12”) on centre on every Z-channel. The exposed joints were caulked and taped.

On the other side of the CLT wall (small chamber side), two layers of 16 mm (5/8”) Type X gypsum board were directly attached. The base layer of gypsum board was attached with their long side vertical using 32 mm (1-1/4") long type S screws spaced 305 mm (12”) on centre on every. The face layer were installed with their long side vertical and staggered from the base layer using 50 mm (2") type S screws spaced 305 mm (12”) on centre. Steel studs were installed 19 mm (3/4”) in front of the CLT wall with a spacing of 406 mm (16”) on centre. One layer of 13 mm (1/2”) Type C gypsum board was installed on the decoupled 65 mm (2-1/2”) lightweight steel studs with 65 mm (2-1/2”) Roxul AFB batts in the cavity. The gypsum board was attached using 32 mm (1-1/4") long type S screws spaced 305 mm (12”) on centre. The exposed joints were caulked and taped.



Top View of A1-006070-12W

Specimen Properties

Element	Actual thickness (mm)	Mass (kg)	Mass/length, area or volume
13 mm Type C Gypsum Board	13	89	10.0 kg/m^2
65 mm Steel Studs (26 ga)	65	14	0.6 kg/m
65 mm Roxul AFB ® Batts	65*	27	3.0 kg/m^2
19 mm Air Gap	19	-	- -
16 mm Type X Gypsum Board	16	98	11.0 kg/m^2
16 mm Type X Gypsum Board	16	98	11.0 kg/m^2
175 mm CLT 5-ply	175	812	91.0 kg/m^2
38 mm OC EcoTouch Pink Glass Fibre Batts	38*	5	0.6 kg/m^2
35 mm Z-channels (26 ga)	35	9	0.4 kg/m
16 mm Type X Gypsum Board	16	98	11.0 kg/m^2
16 mm Type X Gypsum Board	16	98	11.0 kg/m^2
Total	**371**	**1348**	**151 kg/m^2**

***** The thicknesses of the insulation batts are not included in the total specimen thickness.

Test Specimen Installation

- The exposed area of the wall specimen used for the calculations of the airborne sound transmission loss was 8.92 m^2 (3.66 m x 2.44 m).
- The mass per area of the elements was calculated using the total area (8.92 m^2).

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ASTM E90 Test Results – Airborne Sound Transmission Loss

Client: Nordic Engineered Wood **Test ID:** TLA-14-090

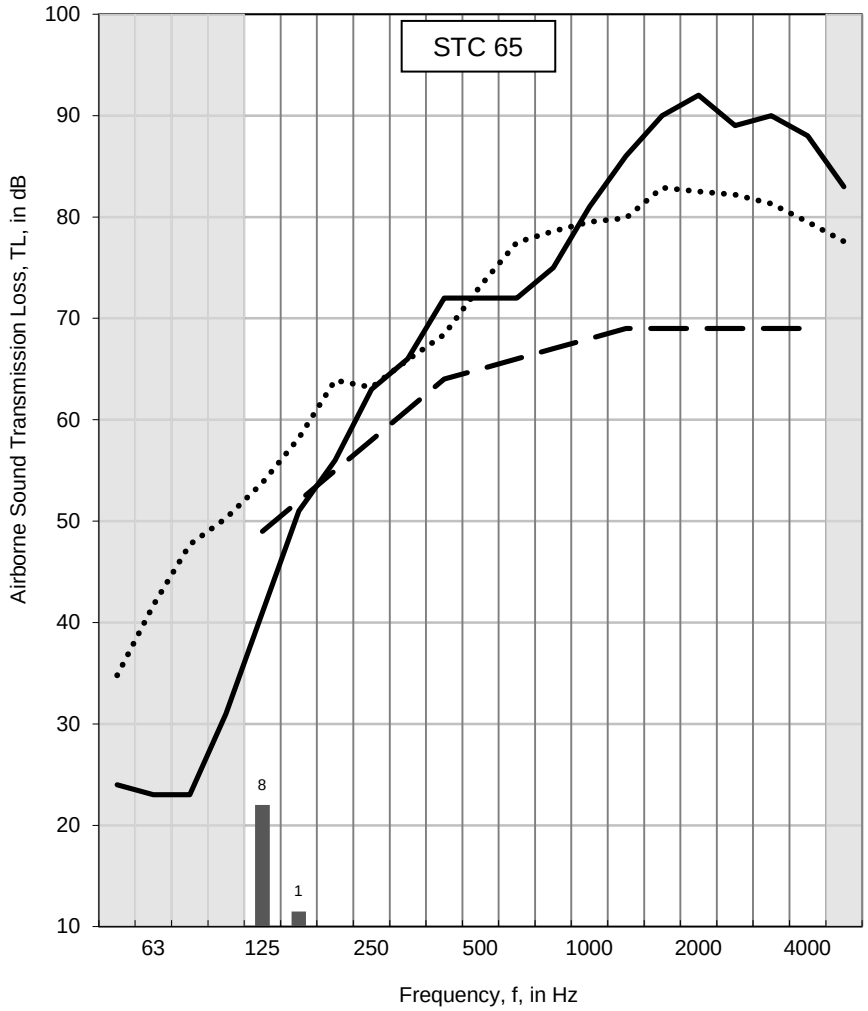
Specimen ID: A1-006070-12W **Date of Test:** December 10, 2014

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Large	255.0	20.4 to 20.5	34.4 to 36.6
Small	140.0	19.1 to 19.8	38.0 to 40.8

Area S of test specimen:	8.92 m^2
Mass per unit area:	151 kg/m^2

f (Hz)	Airborne TL 1/3-octave (dB)	
50	27	c
63	21	
80	19	
100	25	
125	30	
160	32	
200	39	
250	44	
315	50	
400	59	
500	65	
630	69	
800	72	
1000	78	c
1250	83	c
1600	82	*
2000	73	*
2500	69	*
3150	71	*
4000	76	*
5000	79	*
Sound Transmission Class (STC)	**65**	

Sum of Deficiencies (dB)
9
Max. Deficiency (dB)
8 dB at 125 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Airborne sound transmission loss measurements were conducted in accordance with the requirements of ASTM E90-09, "Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements".**

In the graph:
The solid line is the measured sound transmission loss for this specimen. The dashed line is the STC contour fitted to the measured values according to ASTM E413-10. The dotted line (may be above the displayed range) is 10 dB below the flanking limit established for this facility. For any frequency band where the measured transmission loss is above the dotted line, the reported value is potentially limited by flanking transmission via laboratory surfaces, and the true value may be higher than that measured. Bars at the bottom of the graph show deficiencies where the measured data are less than the reference contour as described in the fitting procedure for the STC, defined in ASTM E413-10. The shaded cells in the table and areas in the graph are outside the STC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. The reported values have been corrected according to the procedure outlined in ASTM E90-09. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level, in which case, the corrected values provide an estimate of the lower limit of airborne sound transmission loss.

Client Nordic Engineered Wood
1100 Ave des Canadiens-de-Montreal
Montreal QC H3B 2S2

Specimen CLT 5 ply (175 mm) with two layers of 16 mm Type X gypsum board directly attached with a decoupled steel stud wall with 13 mm Type C gypsum board on one side.

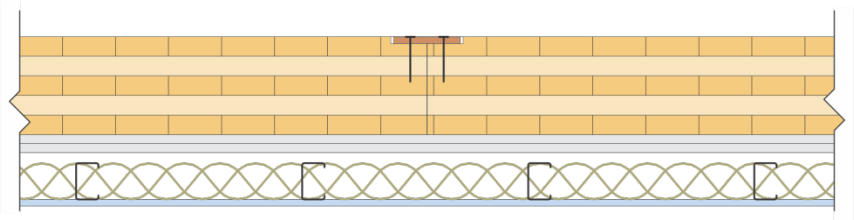
Specimen ID A1-006070-13W

Construction Date: December 10, 2014

Specimen Description

The specimen was composed of two cross-laminated timber (CLT) 5 ply (175 mm thick x 1830 mm wide x 2440 mm long) panels with a vertical butt joint in the middle of the wall. The combined panels filled the entire wall opening of the test frame. The two CLT panels were joined using a 120 mm wide x 12 mm thick plywood strip spanning the full joint (2.44 m). The plywood strip was nailed with common nails 75 mm (3") long spaced 305 mm (12") on centre along the joint with beads of PL premium adhesive between the plywood strip and the CLT panels. The CLT wall was resting on and not attached to the test frame. The air gaps between the edges of the CLT wall and the test frame were filled with glass fiber insulation and backer rod on top.

On one side of the CLT wall (small chamber side), two layers of 16 mm (5/8") Type X gypsum board were directly attached. The base layer of gypsum board was attached with their long side vertical using 32 mm (1-1/4") long type S screws spaced 305 mm (12") on centre. The face layer were installed with their long side vertical and staggered from the base layer using 50 mm (2") type S screws spaced 305 mm (12") on centre. One layer of 13 mm (1/2") Type C gypsum board was installed on decoupled 65 mm (2-1/2") lightweight steel studs with 65 mm (2-1/2") Roxul AFB batts in the cavity. The steel studs were installed 19 mm (3/4") in front of the CLT wall with a spacing of 406 mm (16") on centre. The 13 mm (1/2") Type C gypsum board was attached using 32 mm (1-1/4") long type S screws to every studs. The exposed joints were caulked and taped.



Top View of A1-006070-13W

Specimen Properties

Element	Actual thickness (mm)	Mass (kg)	Mass/length, area or volume
13 mm Type C Gypsum Board	13	89	10.0 kg/m^2
65 mm Steel Studs (26 ga)	65	14	0.6 kg/m
65 mm Roxul AFB ® Batts	65*	27	3.0 kg/m^2
19 mm Air Gap	19	-	- -
16 mm Type X Gypsum Board	16	98	11.0 kg/m^2
16 mm Type X Gypsum Board	16	98	11.0 kg/m^2
175 mm CLT 5-ply	175	812	91.0 kg/m^2
Total	**304**	**1138**	**128 kg/m^2**

***** The thickness of the insulation batts is not included in the total specimen thickness.

Test Specimen Installation

- The exposed area of the wall specimen used for the calculations of the airborne sound transmission loss was 8.92 m^2 (3.66 m x 2.44 m).
- The mass per area of the elements was calculated using the total area (8.92 m^2).

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ASTM E90 Test Results – Airborne Sound Transmission Loss

Client: Nordic Engineered Wood **Test ID:** TLA-14-091

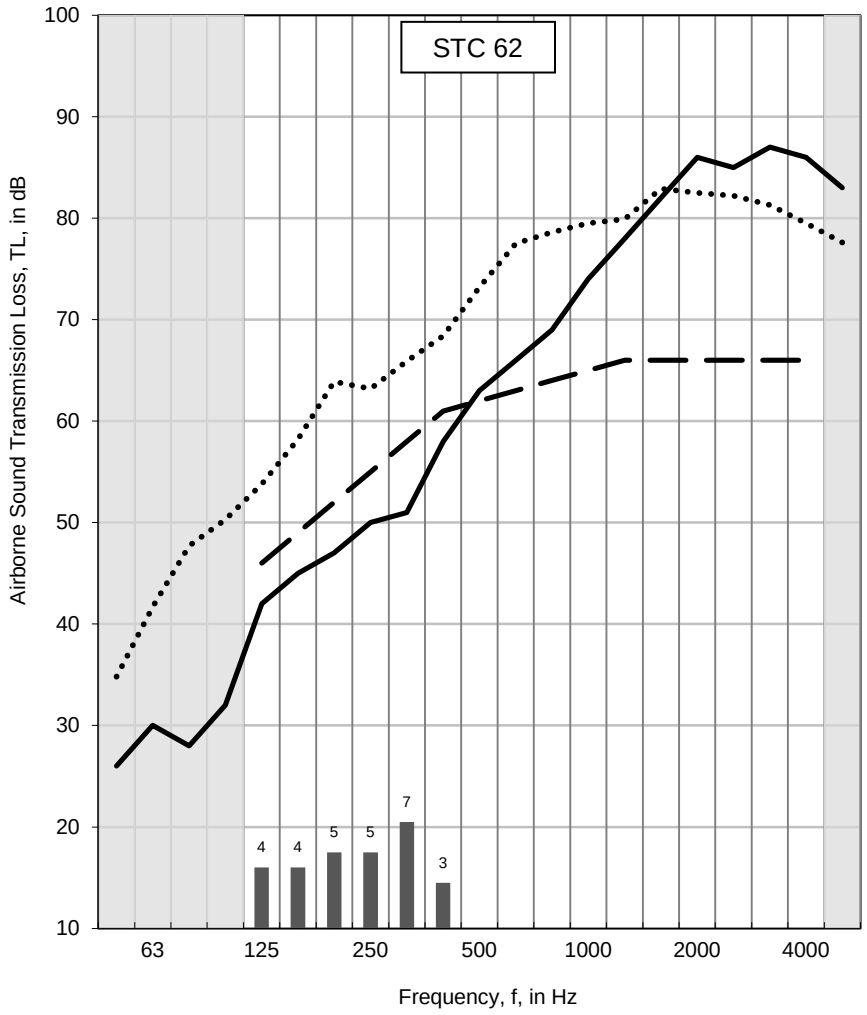
Specimen ID: A1-006070-13W **Date of Test:** December 10, 2014

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Large	255.6	20.4 to 20.6	31.5 to 36.7
Small	140.0	19.0 to 19.1	37.2 to 37.6

Area S of test specimen:	8.92 m^2
Mass per unit area:	128 kg/m^2

f (Hz)	Airborne TL 1/3-octave (dB)	
50	26	c
63	30	
80	28	
100	32	
125	42	
160	45	
200	47	
250	50	
315	51	
400	58	
500	63	
630	66	
800	69	
1000	74	
1250	78	
1600	82	c
2000	86	c
2500	85	c
3150	87	*
4000	86	*
5000	83	*
Sound Transmission Class (STC)	**62**	

Sum of Deficiencies (dB)
28
Max. Deficiency (dB)
7 dB at 315 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Airborne sound transmission loss measurements were conducted in accordance with the requirements of ASTM E90-09, "Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements" with the exception that the humidity variation in the large room was above 3%.**

In the graph:
The solid line is the measured sound transmission loss for this specimen. The dashed line is the STC contour fitted to the measured values according to ASTM E413-10. The dotted line (may be above the displayed range) is 10 dB below the flanking limit established for this facility. For any frequency band where the measured transmission loss is above the dotted line, the reported value is potentially limited by flanking transmission via laboratory surfaces, and the true value may be higher than that measured. Bars at the bottom of the graph show deficiencies where the measured data are less than the reference contour as described in the fitting procedure for the STC, defined in ASTM E413-10. The shaded cells in the table and areas in the graph are outside the STC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. The reported values have been corrected according to the procedure outlined in ASTM E90-09. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level, in which case, the corrected values provide an estimate of the lower limit of airborne sound transmission loss.

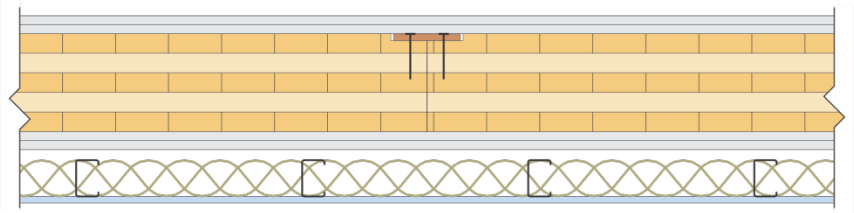
Client	Nordic Engineered Wood 1100 Ave des Canadiens-de-Montreal Montreal QC H3B 2S2
Specimen	***PAL détail 9*** CLT 5 ply (175 mm) with two layers of 16 mm Type X gypsum board directly attached to both sides with a decoupled steel stud wall with 13 mm Type C gypsum board on one side.
Specimen ID	A1-006070-14W
Construction Date:	December 11, 2014

Specimen Description

The specimen was composed of two cross-laminated timber (CLT) 5 ply (175 mm thick x 1830 mm wide x 2440 mm long) panels with a vertical butt joint in the middle of the wall. The combined panels filled the entire wall opening of the test frame. The two CLT panels were joined using a 120 mm wide x 12 mm thick plywood strip spanning the full joint (2.44 m). The plywood strip was nailed with common nails 75 mm (3”) long spaced 305 mm (12”) on centre along the joint with beads of PL premium adhesive between the plywood strip and the CLT panels. The CLT wall was resting on and not attached to the test frame. The air gaps between the edges of the CLT wall and the test frame were filled with glass fiber insulation and backer rod on top.

On one side of the CLT wall (large chamber side), two layers of 16 mm (5/8”) Type X gypsum board were directly attached to the CLT wall. The base layer of gypsum board was attached with their long side vertical using 32 mm (1-1/4") long type S screws spaced 305 mm (12”) on centre. The face layer were installed with their long side vertical and staggered from the base layer using 50 mm (2") type S screws spaced 305 mm (12”) on centre. The exposed joints were caulked and taped.

On one side of the CLT wall (small chamber side), two layers of 16 mm (5/8”) Type X gypsum board were directly attached. The base layer of gypsum board was attached with their long side vertical using 32 mm (1-1/4") long type S screws spaced 305 mm (12”) on centre. The face layer were installed with their long side vertical and staggered from the base layer using 50 mm (2") type S screws spaced 305 mm (12”) on centre. One layer of 13 mm (1/2”) Type C gypsum board was installed on decoupled 65 mm (2-1/2”) lightweight steel studs with 65 mm (2-1/2”) Roxul AFB batts in the cavity. The steel studs were installed 19 mm (3/4”) in front of the CLT wall with a spacing of 406 mm (16”) on centre. The 13 mm (1/2”) Type C gypsum board was attached using 32 mm (1-1/4") long type S screws to every studs. The exposed joints were caulked and taped.



Top View of A1-006070-14W

Specimen Properties

Element	Actual thickness (mm)	Mass (kg)	Mass/length, area or volume
13 mm Type C Gypsum Board	13	89	10.0 kg/m^2
65 mm Steel Studs (26 Ga)	65	14	0.6 kg/m
65 mm Roxul AFB ® Batts	65*	27	3.0 kg/m^2
19 mm Air Gap	19	-	- -
16 mm Type X Gypsum Board	16	98	11.0 kg/m^2
16 mm Type X Gypsum Board	16	98	11.0 kg/m^2
175 mm CLT 5-ply	175	812	91.0 kg/m^2
16 mm Type X Gypsum Board	16	98	11.0 kg/m^2
16 mm Type X Gypsum Board	16	98	11.0 kg/m^2
Total	**336**	**1334**	**150 kg/m^2**

***** The thickness of the insulation batts is not included in the total specimen thickness.

Test Specimen Installation

- The exposed area of the wall specimen used for the calculations of the airborne sound transmission loss was 8.92 m^2 (3.66 m x 2.44 m).
- The mass per area of the elements was calculated using the total area (8.92 m^2).

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ASTM E90 Test Results – Airborne Sound Transmission Loss

Client: Nordic Engineered Wood **Test ID:** TLA-14-092

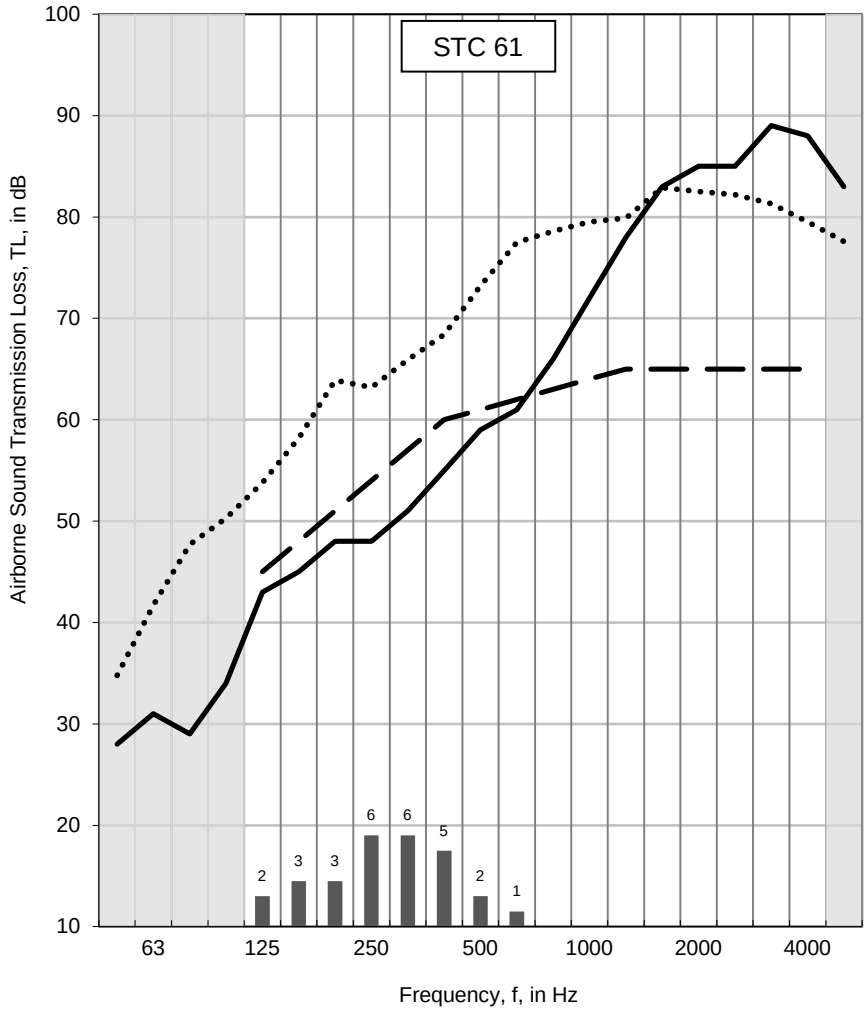
Specimen ID: A1-006070-14W **Date of Test:** December 11, 2014

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Large	255.3	20.3 to 20.7	34.2 to 38.6
Small	140.0	18.9 to 19.0	38.3 to 38.5

Area S of test specimen:	8.92 m^2
Mass per unit area:	150 kg/m^2

f (Hz)	Airborne TL 1/3-octave (dB)	
50	28	
63	31	
80	29	
100	34	
125	43	
160	45	
200	48	
250	48	
315	51	
400	55	
500	59	
630	61	
800	66	
1000	72	
1250	78	
1600	83	c
2000	85	c
2500	85	c
3150	89	*
4000	88	*
5000	83	*
Sound Transmission Class (STC)	**61**	

Sum of Deficiencies (dB)
28
Max. Deficiency (dB)
6 dB at 250 and 315 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Airborne sound transmission loss measurements were conducted in accordance with the requirements of ASTM E90-09, "Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements" with the exception that the humidity variation in the large room was above 3%.**

In the graph:
The solid line is the measured sound transmission loss for this specimen. The dashed line is the STC contour fitted to the measured values according to ASTM E413-10. The dotted line (may be above the displayed range) is 10 dB below the flanking limit established for this facility. For any frequency band where the measured transmission loss is above the dotted line, the reported value is potentially limited by flanking transmission via laboratory surfaces, and the true value may be higher than that measured. Bars at the bottom of the graph show deficiencies where the measured data are less than the reference contour as described in the fitting procedure for the STC, defined in ASTM E413-10. The shaded cells in the table and areas in the graph are outside the STC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. The reported values have been corrected according to the procedure outlined in ASTM E90-09. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level, in which case, the corrected values provide an estimate of the lower limit of airborne sound transmission loss.

Client Nordic Engineered Wood
1100 Ave des Canadiens-de-Montreal
Montreal QC H3B 2S2

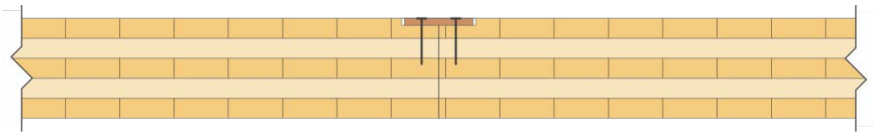
Specimen Bare CLT 5 ply (175 mm)

Specimen ID A1-006070-01F

Construction Date: December 10, 2014

Specimen Description

The specimen was composed of two cross-laminated timber (CLT) 5 ply (175 mm thick x 1989 mm wide x 4872 mm long) panels with a butt joint in the middle of the floor. The combined panels filled the entire floor opening of the test frame. The two CLT panels were joined using a 120 mm wide x 12 mm thick plywood strip spanning the full joint (4.9 m). The plywood strip was nailed with common nails 75 mm (3") long spaced 305 mm (12") on centre along the joint with beads of PL premium adhesive between the plywood strip and the CLT panels. The CLT floor was resting on the lip of the test frame and was not fastened to the test frame. The air gaps between the edges of the CLT floor and the test frame were filled with glass fiber insulation and covered with cloth tape. Duct putty was installed around the lower perimeter of the test frame and the CLT.



Cross-section of A1-006070-01F

Specimen Properties

Element	Actual thickness (mm)	Mass (kg)	Mass/length, area or volume
175 mm CLT 5-ply	175	1760	91 kg/m^2
Total	**175**	**1760**	**91 kg/m^2**

Test Specimen Installation

- The exposed area of the floor specimen used for the calculations of the airborne sound transmission loss was 17.85 m^2 (4.71 m x 3.79 m).
- The total area of the floor assembly resting on top of the lip was 19.32 m^2 (4.88 m x 3.96 m).
- The mass per area of the elements above the lip was calculated using the total area (19.32 m^2).

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ASTM E90 Test Results – Airborne Sound Transmission Loss

Client: Nordic Engineered Wood **Test ID:** TLF-14-072

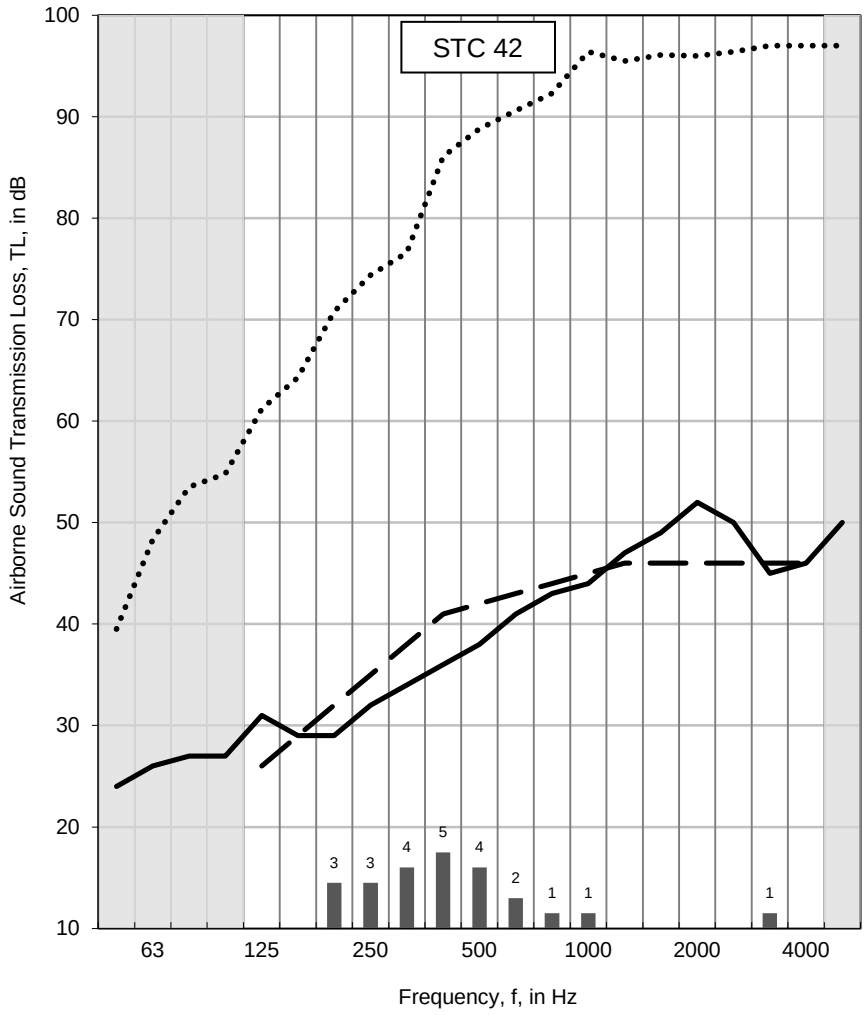
Specimen ID: A1-006070-01F **Date of Test:** December 12, 2014

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Upper	176.1	21.6 to 21.7	33.3 to 33.4
Lower	177.0	17.9 to 17.9	38.1 to 38.1

Area S of test specimen:	17.85 m^2
Mass per unit area:	91 kg/m^2

f (Hz)	Airborne TL (dB)
50	24
63	26
80	27
100	27
125	31
160	29
200	29
250	32
315	34
400	36
500	38
630	41
800	43
1000	44
1250	47
1600	49
2000	52
2500	50
3150	45
4000	46
5000	50
Sound Transmission Class (STC)	**42**

Sum of Deficiencies (dB)
24
Max. Deficiency (dB)
5 dB at 400 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Airborne sound transmission loss measurements were conducted in accordance with the requirements of ASTM E90-09, "Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements".**

In the graph:
The solid line is the measured sound transmission loss for this specimen. The dashed line is the STC contour fitted to the measured values according to ASTM E413-10. The dotted line (may be above the displayed range) is 10 dB below the flanking limit established for this facility. For any frequency band where the measured transmission loss is above the dotted line, the reported value is potentially limited by flanking transmission via laboratory surfaces, and the true value may be higher than that measured. Bars at the bottom of the graph show deficiencies where the measured data are less than the reference contour as described in the fitting procedure for the STC, defined in ASTM E413-10. The shaded cells in the table and areas in the graph are outside the STC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. The reported values have been corrected according to the procedure outlined in ASTM E90-09. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level, in which case, the corrected values provide an estimate of the lower limit of airborne sound transmission loss.

ASTM E492 Test Results – Normalized Impact Sound Pressure Levels

Client: Nordic Engineered Wood **Test ID:** IIF-14-038

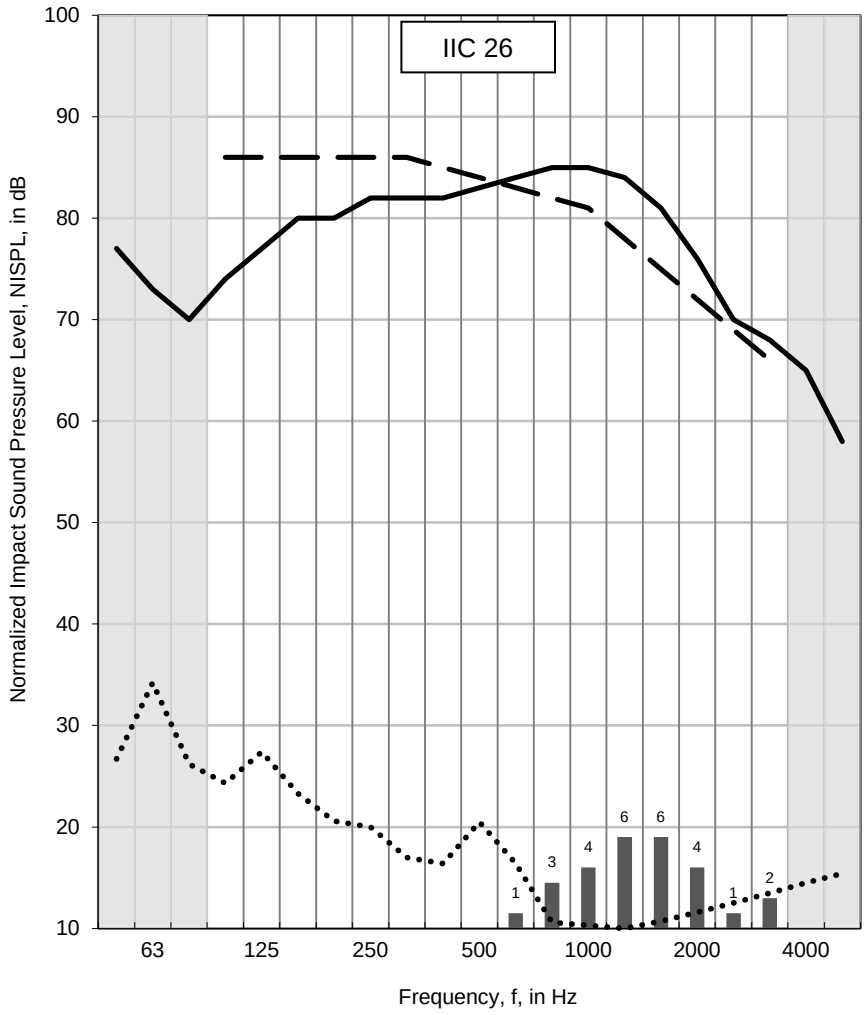
Specimen ID: A1-006070-01F **Date of Test:** December 12, 2014

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Upper	176.1	21.7 to 21.8	32.8 to 33.1
Lower	177.0	17.9 to 18.0	37.9 to 38.0

Area S of test specimen:	17.85 m^2
Mass per unit area:	91 kg/m^2

f (Hz)	NISPL (dB)
50	77
63	73
80	70
100	74
125	77
160	80
200	80
250	82
315	82
400	82
500	83
630	84
800	85
1000	85
1250	84
1600	81
2000	76
2500	70
3150	68
4000	65
5000	58
Impact Insulation Class (IIC)	**26**

Sum of Positive Differences (dB)
27
Max. Positive Difference (dB)
6 dB at 1250 and 1600 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Measurements of normalized impact sound pressure level (NISPL) were conducted in accordance with the requirements of ASTM E492-09, "Standard Laboratory Measurement of Impact Sound Transmission through Floor-Ceiling Assemblies Using the Tapping Machine".**

In the graph:
The solid line is the measured normalized impact sound pressure level (NISPL) for this specimen. The dashed line is the IIC contour fitted to the measured values according to ASTM E989-06. The dotted line is the background sound level measured in the receiving room during this test (may be below the displayed range). For any frequency where measured NISPL is less than 10 dB above the dotted line, the reported values were adjusted as noted below. Bars at bottom of graph show positive differences; where the measured data are greater than the reference contour as defined in ASTM E989-06. Shaded cells in the table and areas in the graph are outside the IIC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level and the reported values of NISPL provide an estimate of the upper limit of normalized impact sound pressure level, according to the procedure outlined in ASTM E492-09. The reported values of NISPL have been corrected according to the procedure outlined in ASTM E492-09.

Client Nordic Engineered Wood
1100 Ave des Canadiens-de-Montreal
Montreal QC H3B 2S2

Specimen 38 mm (1-1/2") precast concrete slab on 13 mm (1/2") rubber membrane placed on top of a CLT 5 ply (175 mm).

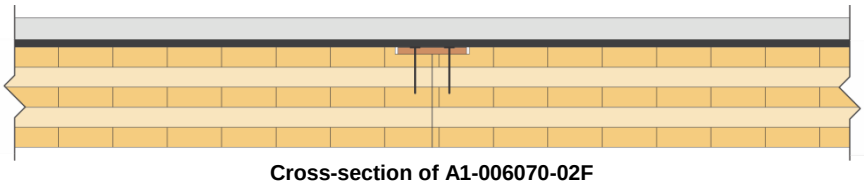
Specimen ID A1-006070-02F

Construction Date: January 7, 2015 to January 8, 2015

Specimen Description

The specimen was composed of two cross-laminated timber (CLT) 5 ply (175 mm thick x 1989 mm wide x 4872 mm long) panels with a butt joint in the middle of the floor. The combined panels filled the entire floor opening of the test frame. The two CLT panels were joined using a 120 mm wide x 12 mm thick plywood strip spanning the full joint (4.9 m). The plywood strip was nailed with common nails 75 mm (3") long spaced 305 mm (12") on centre along the joint with beads of PL premium adhesive between the plywood strip and the CLT panels. The CLT floor was resting on the lip of the test frame and was not fastened to the test frame. The air gaps between the edges of the CLT floor and the test frame were filled with glass fiber insulation and covered with cloth tape. Duct putty was installed around the lower perimeter of the test frame and the CLT.

A 38 mm (1-1/2") precast concrete slab was placed on a 13 mm (1/2") INSONOMAT rubber membrane which was placed on the CLT floor.



Cross-section of A1-006070-02F

Specimen Properties

Element	Actual thickness (mm)	Mass (kg)	Mass/length, area or volume
38 mm Precast Concrete Slab	38	2023	103.0 kg/m^2
13 mm INSONOMAT Rubber Membrane	13	90	4.5 kg/m^2
175 mm CLT 5-ply	175	1760	91.0 kg/m^2
Total	**226**	**3873**	**199 kg/m^2**

Test Specimen Installation

- The exposed area of the floor specimen used for the calculations of the airborne sound transmission loss was 17.85 m^2 (4.71 m x 3.79 m).
- The total area of the floor assembly resting on top of the lip was 19.32 m^2 (4.88 m x 3.96 m).
- The mass per area of the elements above the lip was calculated using the total area (19.32 m^2).

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ASTM E90 Test Results – Airborne Sound Transmission Loss

Client: Nordic Engineered Wood **Test ID:** TLF-15-002

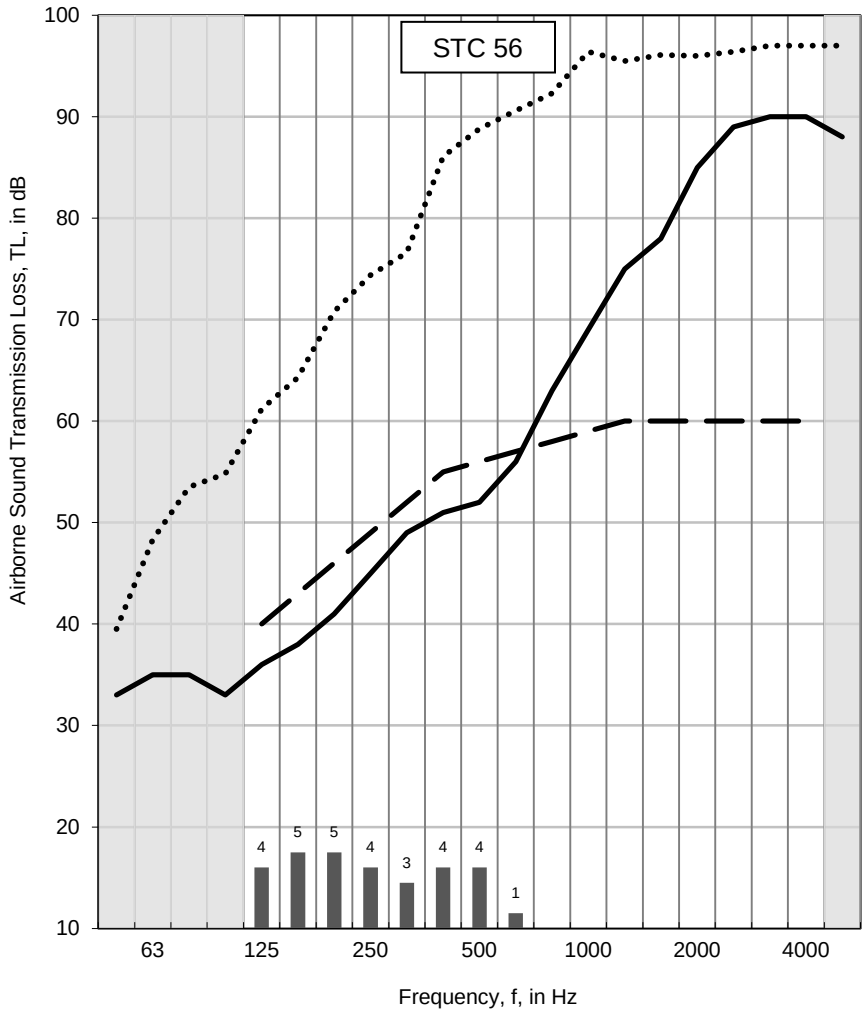
Specimen ID: A1-006070-02F **Date of Test:** January 9, 2015

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Upper	175.1	21.6 to 21.6	34.5 to 34.7
Lower	177.0	15.7 to 15.9	42.4 to 43.1

Area S of test specimen:	17.85 m^2
Mass per unit area:	199 kg/m^2

f (Hz)	Airborne TL (dB)	
50	33	
63	35	
80	35	
100	33	
125	36	
160	38	
200	41	
250	45	
315	49	
400	51	
500	52	
630	56	
800	63	
1000	69	
1250	75	
1600	78	
2000	85	
2500	89	c
3150	90	c
4000	90	c
5000	88	
Sound Transmission Class (STC)	**56**	

Sum of Deficiencies (dB)
30
Max. Deficiency (dB)
5 dB at 160 and 200 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Airborne sound transmission loss measurements were conducted in accordance with the requirements of ASTM E90-09, "Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements" with the exception that the temperature in the lower room was lower than 17ºC.**

In the graph:
The solid line is the measured sound transmission loss for this specimen. The dashed line is the STC contour fitted to the measured values according to ASTM E413-10. The dotted line (may be above the displayed range) is 10 dB below the flanking limit established for this facility. For any frequency band where the measured transmission loss is above the dotted line, the reported value is potentially limited by flanking transmission via laboratory surfaces, and the true value may be higher than that measured. Bars at the bottom of the graph show deficiencies where the measured data are less than the reference contour as described in the fitting procedure for the STC, defined in ASTM E413-10. The shaded cells in the table and areas in the graph are outside the STC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. The reported values have been corrected according to the procedure outlined in ASTM E90-09. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level, in which case, the corrected values provide an estimate of the lower limit of airborne sound transmission loss.

ASTM E492 Test Results – Normalized Impact Sound Pressure Levels

Client: Nordic Engineered Wood **Test ID:** IIF-15-001

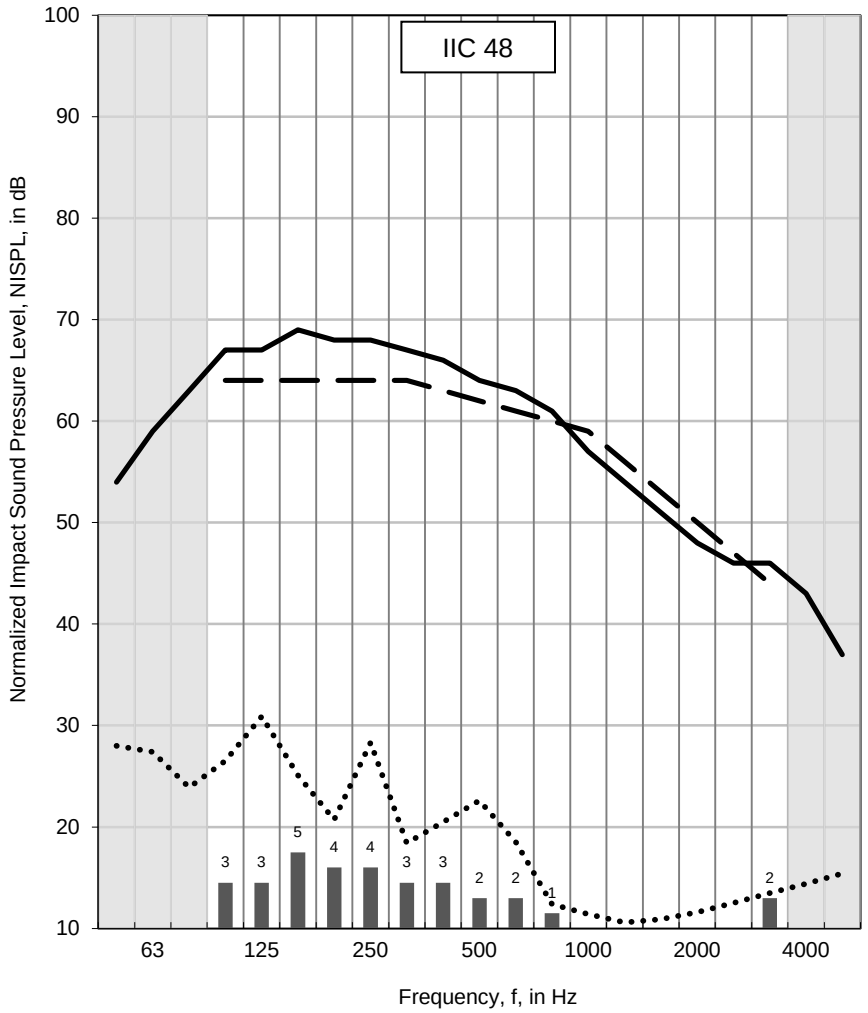
Specimen ID: A1-006070-02F **Date of Test:** January 8, 2015

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Upper	175.1	20.2 to 20.4	18.4 to 19.5
Lower	177.0	16.0 to 17.0	40.6 to 42.3

Area S of test specimen:	17.85 m^2
Mass per unit area:	199 kg/m^2

f (Hz)	NISPL (dB)
50	54
63	59
80	63
100	67
125	67
160	69
200	68
250	68
315	67
400	66
500	64
630	63
800	61
1000	57
1250	54
1600	51
2000	48
2500	46
3150	46
4000	43
5000	37
Impact Insulation Class (IIC)	**48**

Sum of Positive Differences (dB)
32
Max. Positive Difference (dB)
5 dB at 160 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Measurements of normalized impact sound pressure level (NISPL) were conducted in accordance with the requirements of ASTM E492-09, "Standard Laboratory Measurement of Impact Sound Transmission through Floor-Ceiling Assemblies Using the Tapping Machine" with the exception that the temperature in the lower room was lower than 17ºC.**

In the graph:
The solid line is the measured normalized impact sound pressure level (NISPL) for this specimen. The dashed line is the IIC contour fitted to the measured values according to ASTM E989-06. The dotted line is the background sound level measured in the receiving room during this test (may be below the displayed range). For any frequency where measured NISPL is less than 10 dB above the dotted line, the reported values were adjusted as noted below. Bars at bottom of graph show positive differences; where the measured data are greater than the reference contour as defined in ASTM E989-06. Shaded cells in the table and areas in the graph are outside the IIC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level and the reported values of NISPL provide an estimate of the upper limit of normalized impact sound pressure level, according to the procedure outlined in ASTM E492-09. The reported values of NISPL have been corrected according to the procedure outlined in ASTM E492-09.

Client Nordic Engineered Wood
1100 Ave des Canadiens-de-Montreal
Montreal QC H3B 2S2

Specimen 10 mm floating engineered wood floor placed on a 2 mm closed cell foam on 38 mm (1-1/2") precast concrete slab on 13 mm (1/2") rubber membrane placed on top of a CLT 5 ply (175 mm).

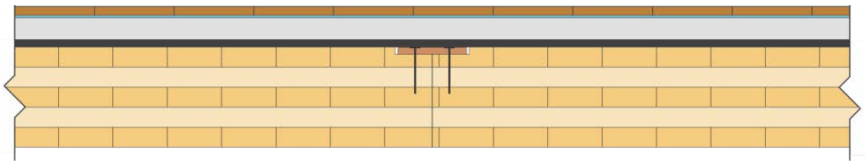
Specimen ID A1-006070-03F

Construction Date: January 28, 2015 to January 30, 2015

Specimen Description

The specimen was composed of two cross-laminated timber (CLT) 5 ply (175 mm thick x 1989 mm wide x 4872 mm long) panels with a butt joint in the middle of the floor. The combined panels filled the entire floor opening of the test frame. The two CLT panels were joined using a 120 mm wide x 12 mm thick plywood strip spanning the full joint (4.9 m). The plywood strip was nailed with common nails 75 mm (3") long spaced 305 mm (12") on centre along the joint with beads of PL premium adhesive between the plywood strip and the CLT panels. The CLT floor was resting on the lip of the test frame and was not fastened to the test frame. The air gaps between the edges of the CLT floor and the test frame were filled with glass fiber insulation and covered with cloth tape. Duct putty was installed around the lower perimeter of the test frame and the CLT.

Engineered floating floor (TORLYS Everest Premier Hardwood – 10 mm thick) with attached cork underlay was installed on top of a 2 mm Roberts® Soft Stride closed cell foam which was placed on top of a 38 mm (1-1/2") precast concrete slab. The 38 mm precast concrete slab was placed on top of 13 mm INSONOMAT rubber membrane which was placed on the CLT floor.



Cross-section of A1-006070-03F

Specimen Properties

Element	Actual thickness (mm)	Mass (kg)	Mass/length, area or volume
10 mm TORLYS Everest Premier Hardwood	10	146	7.3 kg/m^2
2 mm Roberts® Soft Stride Closed Cell Foam	2	2.5	0.1 kg/m^2
38 mm Precast Concrete Slab	38	2023	103.0 kg/m^2
13 mm INSONOMAT Rubber Membrane	13	90	4.5 kg/m^2
175 mm CLT 5-ply	175	1760	91.0 kg/m^2
Total	**238**	**4022**	**206 kg/m^2**

Test Specimen Installation

- The exposed area of the floor specimen used for the calculations of the airborne sound transmission loss was 17.85 m^2 (4.71 m x 3.79 m).
- The total area of the floor assembly resting on top of the lip was 19.32 m^2 (4.88 m x 3.96 m).
- The mass per area of the elements above the lip was calculated using the total area (19.32 m^2).

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ASTM E90 Test Results – Airborne Sound Transmission Loss

Client: Nordic Engineered Wood **Test ID:** TLF-15-003

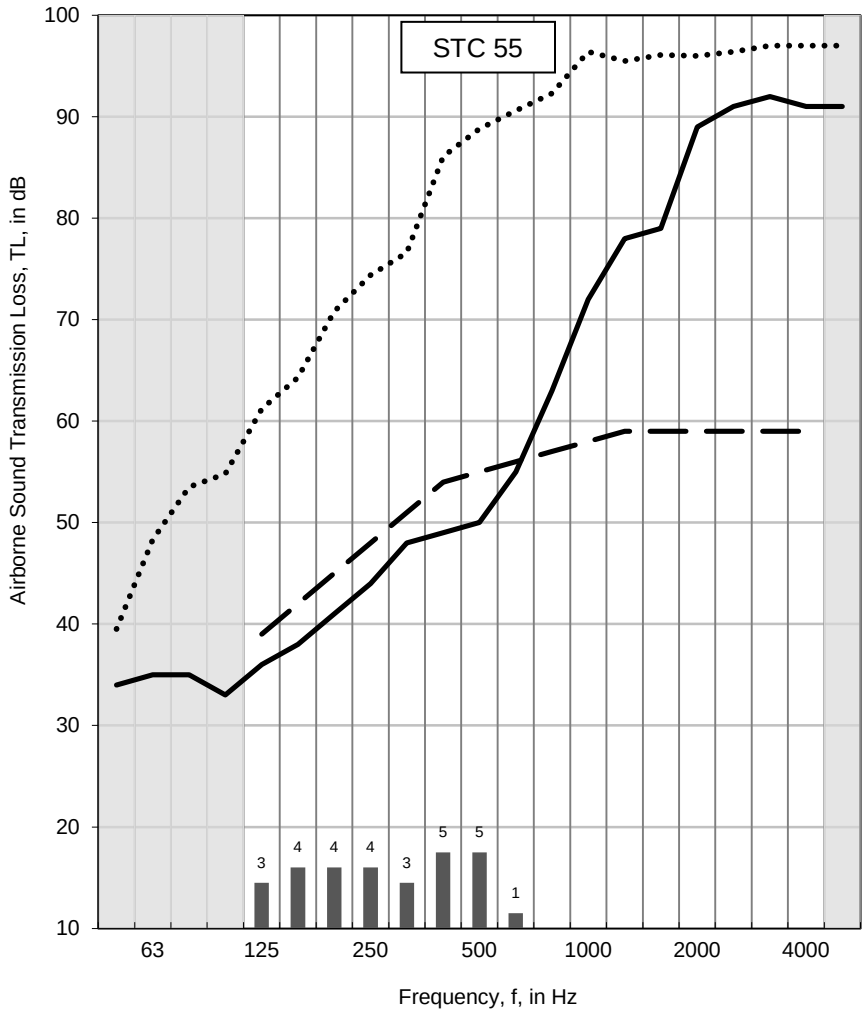
Specimen ID: A1-006070-03F **Date of Test:** January 30, 2015

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Upper	175.0	22.2 to 22.4	35.6 to 36.6
Lower	177.0	17.3 to 18.3	36.9 to 38.2

Area S of test specimen:	17.85 m^2
Mass per unit area:	206 kg/m^2

f (Hz)	Airborne TL (dB)	
50	19	
63	27	
80	20	
100	24	
125	26	
160	26	
200	27	
250	29	
315	30	
400	32	
500	33	
630	34	
800	35	
1000	37	
1250	39	
1600	43	
2000	44	c
2500	46	c
3150	46	c
4000	46	c
5000	47	c
Sound Transmission Class (STC)	**55**	

Sum of Deficiencies (dB)
29
Max. Deficiency (dB)
5 dB at 400 and 500 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Airborne sound transmission loss measurements were conducted in accordance with the requirements of ASTM E90-09, "Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements".**

In the graph:
The solid line is the measured sound transmission loss for this specimen. The dashed line is the STC contour fitted to the measured values according to ASTM E413-10. The dotted line (may be above the displayed range) is 10 dB below the flanking limit established for this facility. For any frequency band where the measured transmission loss is above the dotted line, the reported value is potentially limited by flanking transmission via laboratory surfaces, and the true value may be higher than that measured. Bars at the bottom of the graph show deficiencies where the measured data are less than the reference contour as described in the fitting procedure for the STC, defined in ASTM E413-10. The shaded cells in the table and areas in the graph are outside the STC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. The reported values have been corrected according to the procedure outlined in ASTM E90-09. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level, in which case, the corrected values provide an estimate of the lower limit of airborne sound transmission loss.

ASTM E492 Test Results – Normalized Impact Sound Pressure Levels

Client: Nordic Engineered Wood **Test ID:** IIF-15-002

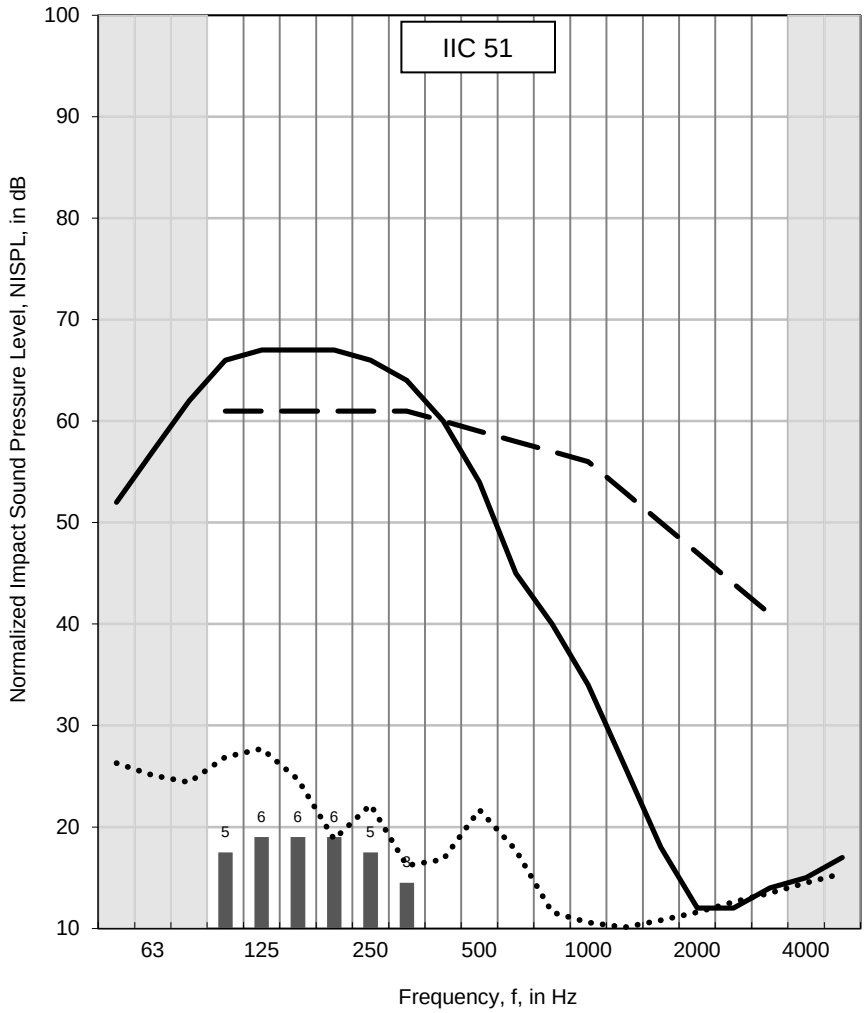
Specimen ID: A1-006070-03F **Date of Test:** February 2, 2015

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Upper	175.0	21.0 to 21.0	34.5 to 36.3
Lower	177.0	17.0 to 17.6	37.0 to 38.5

Area S of test specimen:	17.85 m^2
Mass per unit area:	206 kg/m^2

f (Hz)	NISPL (dB)	
50	52	
63	57	
80	62	
100	66	
125	67	
160	67	
200	67	
250	66	
315	64	
400	60	
500	54	
630	45	
800	40	
1000	34	
1250	26	
1600	18	c
2000	12	*
2500	12	*
3150	14	*
4000	15	*
5000	17	*
Impact Insulation Class (IIC)	**51**	

Sum of Positive Differences (dB)
31
Max. Positive Difference (dB)
6 dB at 125, 160 and 200 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Measurements of normalized impact sound pressure level (NISPL) were conducted in accordance with the requirements of ASTM E492-09, "Standard Laboratory Measurement of Impact Sound Transmission through Floor-Ceiling Assemblies Using the Tapping Machine".**

In the graph:
The solid line is the measured normalized impact sound pressure level (NISPL) for this specimen. The dashed line is the IIC contour fitted to the measured values according to ASTM E989-06. The dotted line is the background sound level measured in the receiving room during this test (may be below the displayed range). For any frequency where measured NISPL is less than 10 dB above the dotted line, the reported values were adjusted as noted below. Bars at bottom of graph show positive differences; where the measured data are greater than the reference contour as defined in ASTM E989-06. Shaded cells in the table and areas in the graph are outside the IIC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level and the reported values of NISPL provide an estimate of the upper limit of normalized impact sound pressure level, according to the procedure outlined in ASTM E492-09. The reported values of NISPL have been corrected according to the procedure outlined in ASTM E492-09.

Client Nordic Engineered Wood
1100 Ave des Canadiens-de-Montreal
Montreal QC H3B 2S2

Specimen 38 mm (1-1/2") precast concrete slab on 10 mm tar boards placed on top of a CLT 5 ply (175 mm).

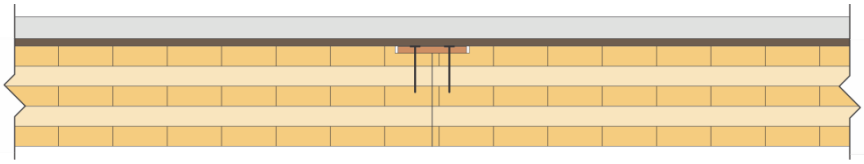
Specimen ID A1-006070-04F

Construction Date: February 3, 2015 to February 4, 2015

Specimen Description

The specimen was composed of two cross-laminated timber (CLT) 5 ply (175 mm thick x 1989 mm wide x 4872 mm long) panels with a butt joint in the middle of the floor. The combined panels filled the entire floor opening of the test frame. The two CLT panels were joined using a 120 mm wide x 12 mm thick plywood strip spanning the full joint (4.9 m). The plywood strip was nailed with common nails 75 mm (3") long spaced 305 mm (12") on centre along the joint with beads of PL premium adhesive between the plywood strip and the CLT panels. The CLT floor was resting on the lip of the test frame and was not fastened to the test frame. The air gaps between the edges of the CLT floor and the test frame were filled with glass fiber insulation and covered with cloth tape. Duct putty was installed around the lower perimeter of the test frame and the CLT.

A 38 mm (1-1/2") precast concrete slab was placed on 10 mm tar boards which were placed on the CLT floor.



Cross-section of A1-006070-04F

Specimen Properties

Element	Actual thickness (mm)	Mass (kg)	Mass/length, area or volume
38 mm Precast Concrete Slab	38	2023	103.0 kg/m^2
10 mm Tar Board (Building Products)	10	56	2.8 kg/m^2
175 mm CLT 5-ply	175	1760	91.0 kg/m^2
Total	**223**	**3839**	**197 kg/m^2**

Test Specimen Installation

- The exposed area of the floor specimen used for the calculations of the airborne sound transmission loss was 17.85 m^2 (4.71 m x 3.79 m).
- The total area of the floor assembly resting on top of the lip was 19.32 m^2 (4.88 m x 3.96 m).
- The mass per area of the elements above the lip was calculated using the total area (19.32 m^2).

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ASTM E90 Test Results – Airborne Sound Transmission Loss

Client: Nordic Engineered Wood **Test ID:** TLF-15-004

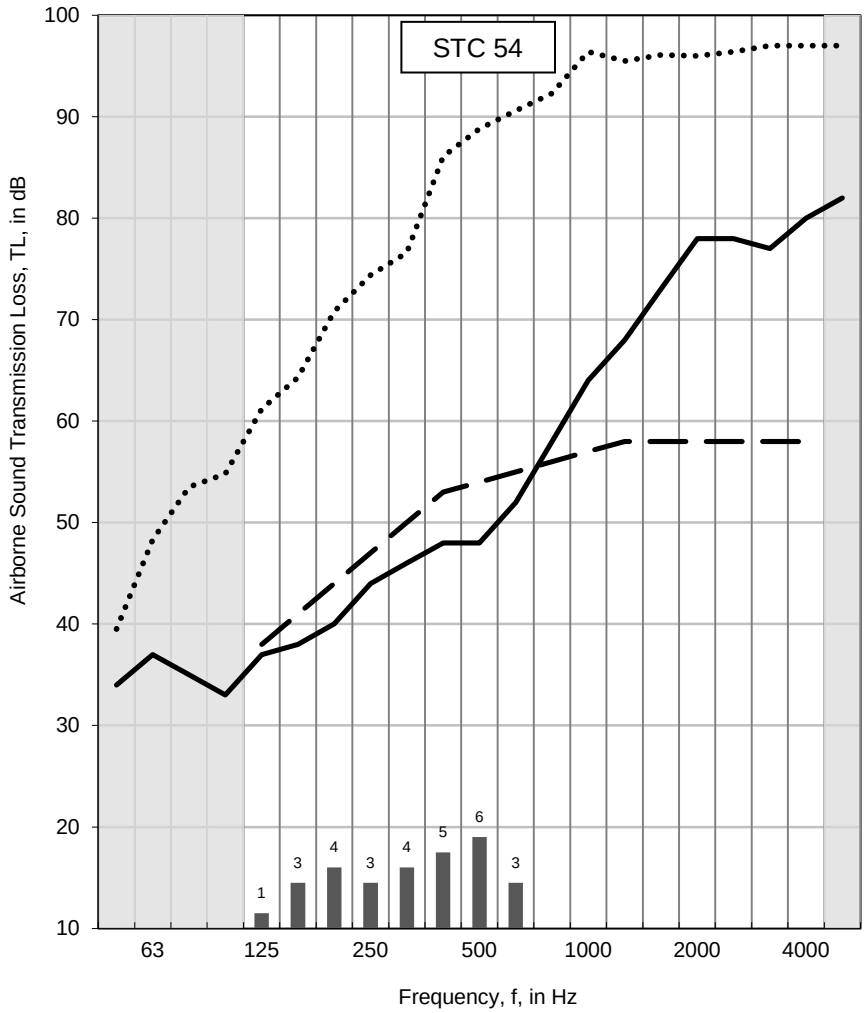
Specimen ID: A1-006070-04F **Date of Test:** February 6, 2015

Room	Volume (m^3)	Air Temperature (°C)	Humidity (%)
Upper	175.2	21.0 to 21.1	33.2 to 33.2
Lower	177.0	16.9 to 16.9	39.9 to 40.0

Area S of test specimen:	17.85 m^2
Mass per unit area:	197 kg/m^2

f (Hz)	Airborne TL (dB)
50	34
63	37
80	35
100	33
125	37
160	38
200	40
250	44
315	46
400	48
500	48
630	52
800	58
1000	64
1250	68
1600	73
2000	78
2500	78
3150	77
4000	80
5000	82
Sound Transmission Class (STC)	**54**

Sum of Deficiencies (dB)
29
Max. Deficiency (dB)
6 dB at 500 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Airborne sound transmission loss measurements were conducted in accordance with the requirements of ASTM E90-09, "Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements" with the exception that the temperature in the lower room was lower than 17ºC.**

In the graph:
The solid line is the measured sound transmission loss for this specimen. The dashed line is the STC contour fitted to the measured values according to ASTM E413-10. The dotted line (may be above the displayed range) is 10 dB below the flanking limit established for this facility. For any frequency band where the measured transmission loss is above the dotted line, the reported value is potentially limited by flanking transmission via laboratory surfaces, and the true value may be higher than that measured. Bars at the bottom of the graph show deficiencies where the measured data are less than the reference contour as described in the fitting procedure for the STC, defined in ASTM E413-10. The shaded cells in the table and areas in the graph are outside the STC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. The reported values have been corrected according to the procedure outlined in ASTM E90-09. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level, in which case, the corrected values provide an estimate of the lower limit of airborne sound transmission loss.

ASTM E492 Test Results – Normalized Impact Sound Pressure Levels

Client: Nordic Engineered Wood **Test ID:** IIF-15-003

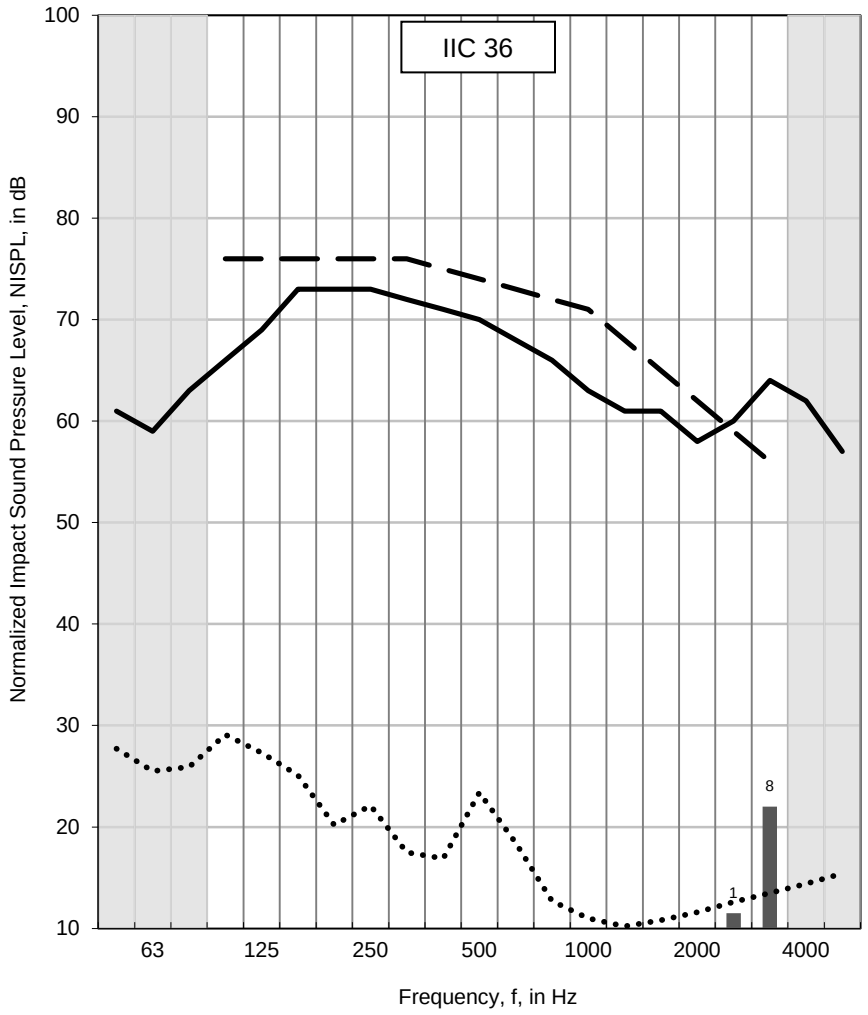
Specimen ID: A1-006070-04F **Date of Test:** February 6, 2015

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Upper	175.2	21.4 to 21.4	33.0 to 33.9
Lower	177.0	17.0 to 17.1	39.6 to 39.8

Area S of test specimen:	17.85 m^2
Mass per unit area:	197 kg/m^2

f (Hz)	NISPL (dB)
50	61
63	59
80	63
100	66
125	69
160	73
200	73
250	73
315	72
400	71
500	70
630	68
800	66
1000	63
1250	61
1600	61
2000	58
2500	60
3150	64
4000	62
5000	57
Impact Insulation Class (IIC)	**36**

Sum of Positive Differences (dB)
9
Max. Positive Difference (dB)
8 dB at 3150 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Measurements of normalized impact sound pressure level (NISPL) were conducted in accordance with the requirements of ASTM E492-09, "Standard Laboratory Measurement of Impact Sound Transmission through Floor-Ceiling Assemblies Using the Tapping Machine".**

In the graph:
The solid line is the measured normalized impact sound pressure level (NISPL) for this specimen. The dashed line is the IIC contour fitted to the measured values according to ASTM E989-06. The dotted line is the background sound level measured in the receiving room during this test (may be below the displayed range). For any frequency where measured NISPL is less than 10 dB above the dotted line, the reported values were adjusted as noted below. Bars at bottom of graph show positive differences; where the measured data are greater than the reference contour as defined in ASTM E989-06. Shaded cells in the table and areas in the graph are outside the IIC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level and the reported values of NISPL provide an estimate of the upper limit of normalized impact sound pressure level, according to the procedure outlined in ASTM E492-09. The reported values of NISPL have been corrected according to the procedure outlined in ASTM E492-09.

Client Nordic Engineered Wood
1100 Ave des Canadiens-de-Montreal
Montreal QC H3B 2S2

Specimen 10 mm floating engineered wood floor placed on a 2 mm closed cell foam on 38 mm (1-1/2") precast concrete slab on 10 mm tar boards placed on top of a CLT 5 ply (175 mm).

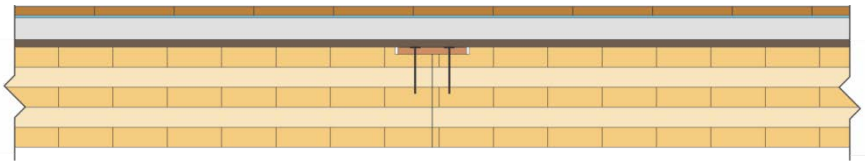
Specimen ID A1-006070-05F

Construction Date: February 9, 2015 to February 10, 2015

Specimen Description

The specimen was composed of two cross-laminated timber (CLT) 5 ply (175 mm thick x 1989 mm wide x 4872 mm long) panels with a butt joint in the middle of the floor. The combined panels filled the entire floor opening of the test frame. The two CLT panels were joined using a 120 mm wide x 12 mm thick plywood strip spanning the full joint (4.9 m). The plywood strip was nailed with common nails 75 mm (3") long spaced 305 mm (12") on centre along the joint with beads of PL premium adhesive between the plywood strip and the CLT panels. The CLT floor was resting on the lip of the test frame and was not fastened to the test frame. The air gaps between the edges of the CLT floor and the test frame were filled with glass fiber insulation and covered with cloth tape. Duct putty was installed around the lower perimeter of the test frame and the CLT.

Engineered floating floor (TORLYS Everest Premier Hardwood – 10 mm thick) with attached cork underlay was installed on top of a 2 mm Roberts® Soft Stride closed cell foam which was placed on top of a 38 mm (1-1/2") precast concrete slab. The 38 mm precast concrete slab was placed on top of 10 mm tar boards which was placed on the CLT floor.



Cross-section of A1-006070-05F

Specimen Properties

Element	Actual thickness (mm)	Mass (kg)	Mass/length, area or volume
10 mm TORLYS Everest Premier Hardwood	10	146	7.3 kg/m^2
2 mm Roberts® Soft Stride Closed Cell Foam	2	2.5	0.1 kg/m^2
38 mm Precast Concrete Slab	38	2023	103.0 kg/m^2
10 mm Tar Board (Building Products)	10	56	2.8 kg/m^2
175 mm CLT 5-ply	175	1760	91.0 kg/m^2
Total	**235**	**3988**	**204 kg/m^2**

Test Specimen Installation

- The exposed area of the floor specimen used for the calculations of the airborne sound transmission loss was 17.85 m^2 (4.71 m x 3.79 m).
- The total area of the floor assembly resting on top of the lip was 19.32 m^2 (4.88 m x 3.96 m).
- The mass per area of the elements above the lip was calculated using the total area (19.32 m^2).

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ASTM E90 Test Results – Airborne Sound Transmission Loss

Client: Nordic Engineered Wood **Test ID:** TLF-15-005

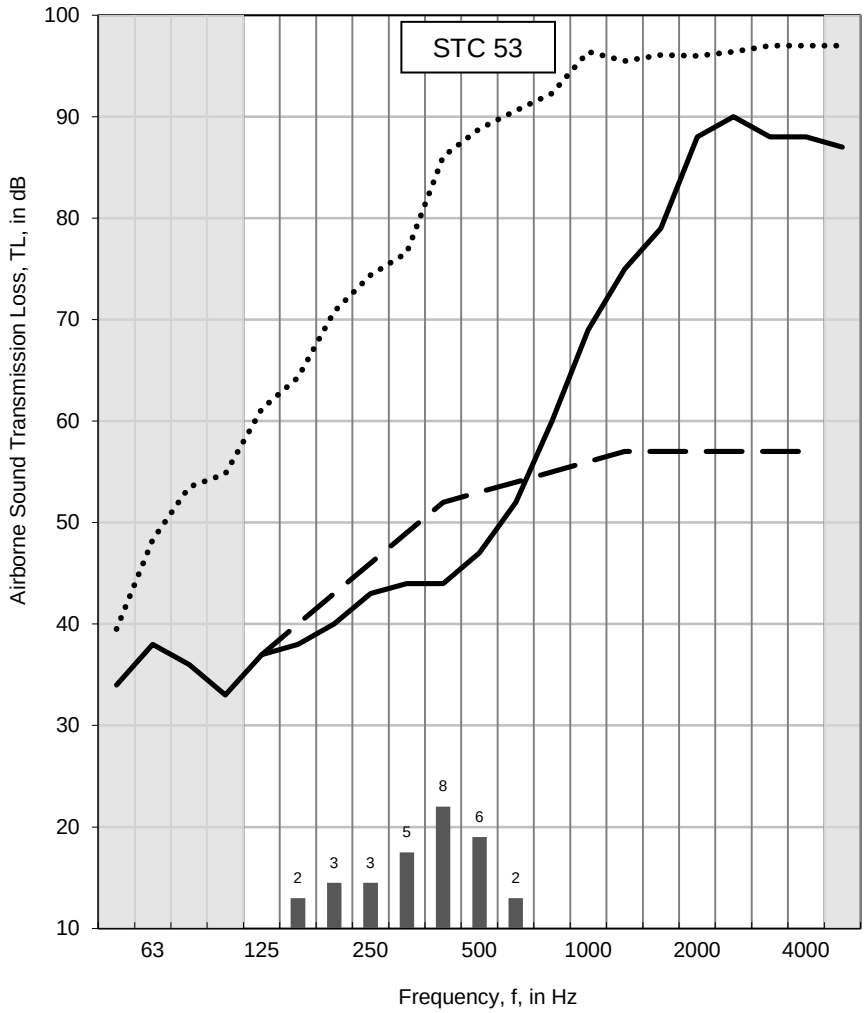
Specimen ID: A1-006070-05F **Date of Test:** February 10, 2015

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Upper	175.0	21.8 to 21.9	33.3 to 33.6
Lower	177.0	16.9 to 17.0	41.1 to 41.3

Area S of test specimen:	17.85 m^2
Mass per unit area:	204 kg/m^2

f (Hz)	Airborne TL (dB)	
50	34	
63	38	
80	36	
100	33	
125	37	
160	38	
200	40	
250	43	
315	44	
400	44	
500	47	
630	52	
800	60	
1000	69	
1250	75	
1600	79	
2000	88	
2500	90	c
3150	88	
4000	88	
5000	87	
Sound Transmission Class (STC)	**53**	

Sum of Deficiencies (dB)
29
Max. Deficiency (dB)
8 dB at 400 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Airborne sound transmission loss measurements were conducted in accordance with the requirements of ASTM E90-09, "Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements" with the exception that the temperature in the lower room was lower than 17ºC.**

In the graph:
The solid line is the measured sound transmission loss for this specimen. The dashed line is the STC contour fitted to the measured values according to ASTM E413-10. The dotted line (may be above the displayed range) is 10 dB below the flanking limit established for this facility. For any frequency band where the measured transmission loss is above the dotted line, the reported value is potentially limited by flanking transmission via laboratory surfaces, and the true value may be higher than that measured. Bars at the bottom of the graph show deficiencies where the measured data are less than the reference contour as described in the fitting procedure for the STC, defined in ASTM E413-10. The shaded cells in the table and areas in the graph are outside the STC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. The reported values have been corrected according to the procedure outlined in ASTM E90-09. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level, in which case, the corrected values provide an estimate of the lower limit of airborne sound transmission loss.

ASTM E492 Test Results – Normalized Impact Sound Pressure Levels

Client: Nordic Engineered Wood **Test ID:** IIF-15-004

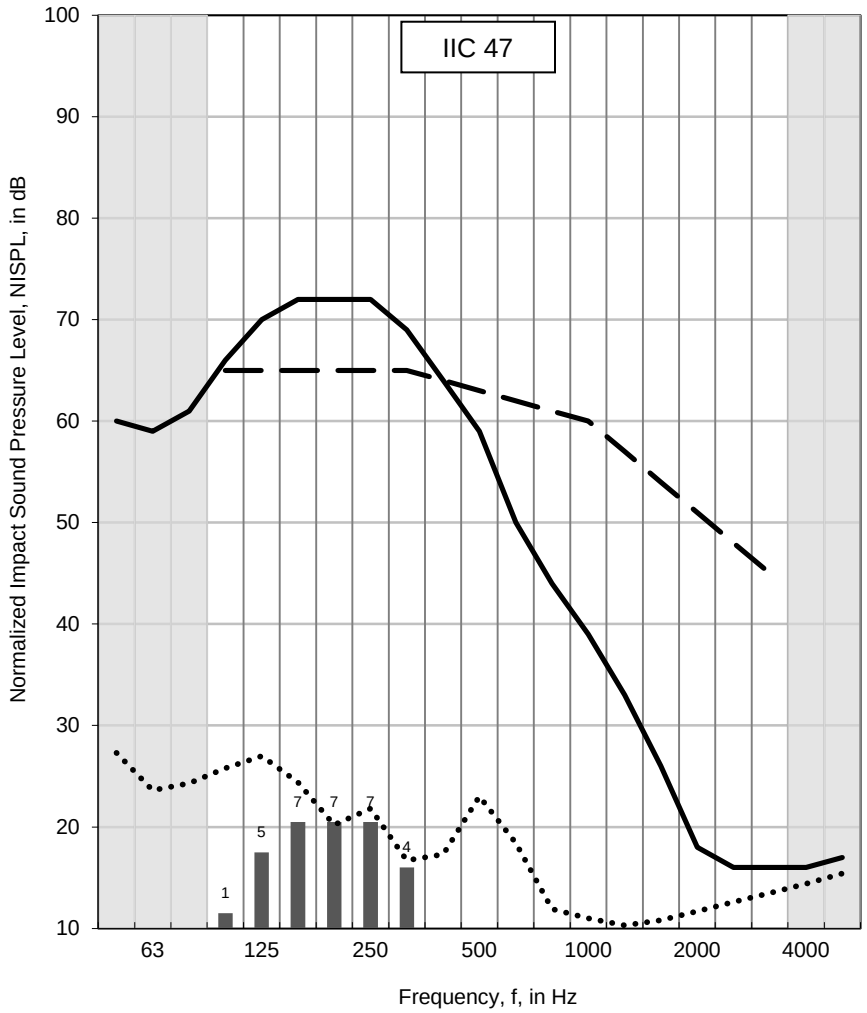
Specimen ID: A1-006070-05F **Date of Test:** February 10, 2015

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Upper	175.0	21.5 to 21.7	33.9 to 34.6
Lower	177.0	17.1 to 17.8	39.1 to 40.6

Area S of test specimen:	17.85 m^2
Mass per unit area:	204 kg/m^2

f (Hz)	NISPL (dB)	
50	60	
63	59	
80	61	
100	66	
125	70	
160	72	
200	72	
250	72	
315	69	
400	64	
500	59	
630	50	
800	44	
1000	39	
1250	33	
1600	26	
2000	18	*
2500	16	*
3150	16	*
4000	16	*
5000	17	*
Impact Insulation Class (IIC)	**47**	

Sum of Positive Differences (dB)
31
Max. Positive Difference (dB)
7 dB at 160, 200 and 250 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Measurements of normalized impact sound pressure level (NISPL) were conducted in accordance with the requirements of ASTM E492-09, "Standard Laboratory Measurement of Impact Sound Transmission through Floor-Ceiling Assemblies Using the Tapping Machine".**

In the graph:
The solid line is the measured normalized impact sound pressure level (NISPL) for this specimen. The dashed line is the IIC contour fitted to the measured values according to ASTM E989-06. The dotted line is the background sound level measured in the receiving room during this test (may be below the displayed range). For any frequency where measured NISPL is less than 10 dB above the dotted line, the reported values were adjusted as noted below. Bars at bottom of graph show positive differences; where the measured data are greater than the reference contour as defined in ASTM E989-06. Shaded cells in the table and areas in the graph are outside the IIC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level and the reported values of NISPL provide an estimate of the upper limit of normalized impact sound pressure level, according to the procedure outlined in ASTM E492-09. The reported values of NISPL have been corrected according to the procedure outlined in ASTM E492-09.

Client Nordic Engineered Wood
1100 Ave des Canadiens-de-Montreal
Montreal QC H3B 2S2

Specimen 38 mm (1-1/2") precast concrete slab on 9 mm closed cell foam placed on top of a CLT 5 ply (175 mm).

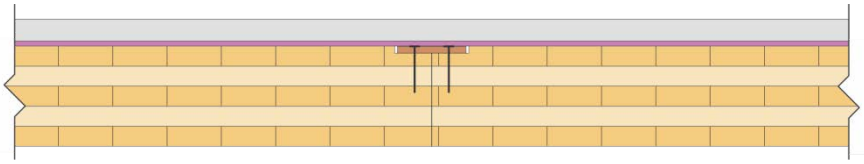
Specimen ID A1-006070-06F

Construction Date: February 11, 2015

Specimen Description

The specimen was composed of two cross-laminated timber (CLT) 5 ply (175 mm thick x 1989 mm wide x 4872 mm long) panels with a butt joint in the middle of the floor. The combined panels filled the entire floor opening of the test frame. The two CLT panels were joined using a 120 mm wide x 12 mm thick plywood strip spanning the full joint (4.9 m). The plywood strip was nailed with common nails 75 mm (3") long spaced 305 mm (12") on centre along the joint with beads of PL premium adhesive between the plywood strip and the CLT panels. The CLT floor was resting on the lip of the test frame and was not fastened to the test frame. The air gaps between the edges of the CLT floor and the test frame were filled with glass fiber insulation and covered with cloth tape. Duct putty was installed around the lower perimeter of the test frame and the CLT.

A 38 mm (1-1/2") precast concrete slab was placed on 9 mm Owens Corning QuietZone® closed cell foam which was placed on the CLT floor.



Cross-section of A1-006070-06F

Specimen Properties

Element	Actual thickness (mm)	Mass (kg)	Mass/length, area or volume
38 mm Precast Concrete Slab	38	2023	103.0 kg/m^2
9 mm Owens Corning QuietZone® Closed Cell Foam	9	7.5	0.4 kg/m^2
175 mm CLT 5-ply	175	1760	91.0 kg/m^2
Total	**222**	**3791**	**194 kg/m^2**

Test Specimen Installation

- The exposed area of the floor specimen used for the calculations of the airborne sound transmission loss was 17.85 m^2 (4.71 m x 3.79 m).
- The total area of the floor assembly resting on top of the lip was 19.32 m^2 (4.88 m x 3.96 m).
- The mass per area of the elements above the lip was calculated using the total area (19.32 m^2).

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ASTM E90 Test Results – Airborne Sound Transmission Loss

Client: Nordic Engineered Wood **Test ID:** TLF-15-006

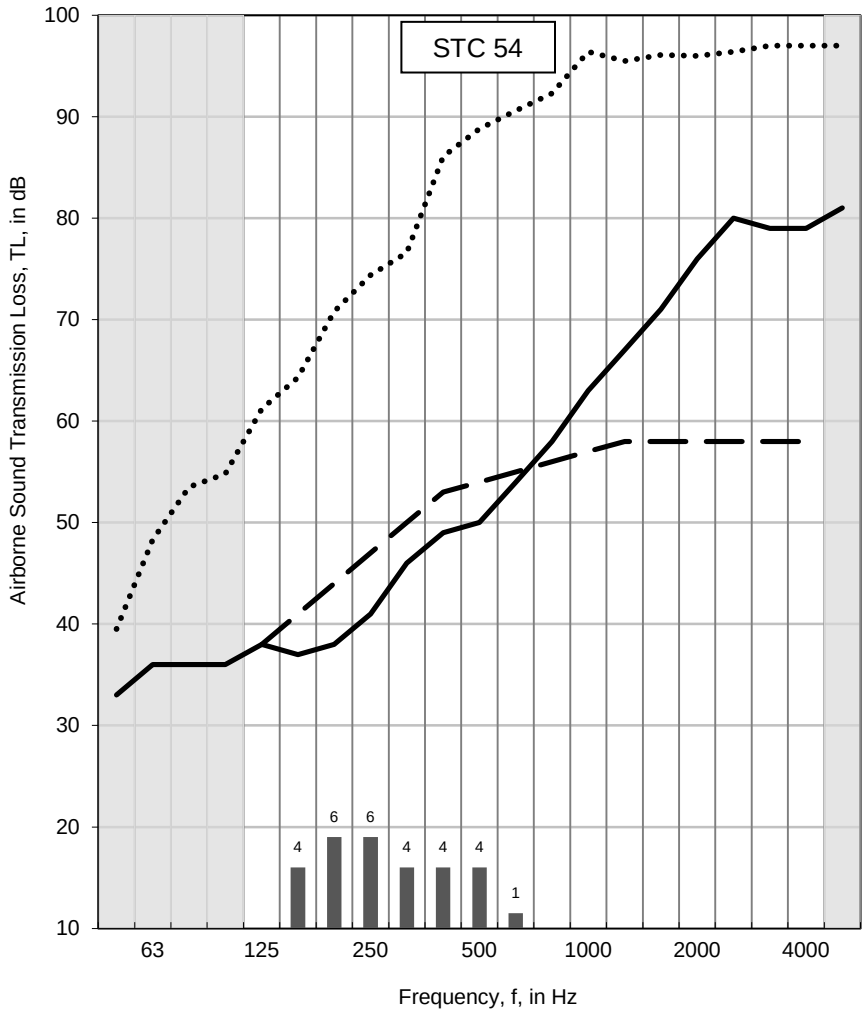
Specimen ID: A1-006070-06F **Date of Test:** February 12, 2015

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Upper	175.3	23.9 to 24.1	36.6 to 37.3
Lower	177.0	18.2 to 18.3	42.6 to 42.7

Area S of test specimen:	17.85 m^2
Mass per unit area:	194 kg/m^2

f (Hz)	Airborne TL (dB)
50	33
63	36
80	36
100	36
125	38
160	37
200	38
250	41
315	46
400	49
500	50
630	54
800	58
1000	63
1250	67
1600	71
2000	76
2500	80
3150	79
4000	79
5000	81
Sound Transmission Class (STC)	**54**

Sum of Deficiencies (dB)
29
Max. Deficiency (dB)
6 dB at 200 Hz and 250 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Airborne sound transmission loss measurements were conducted in accordance with the requirements of ASTM E90-09, "Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements".**

In the graph:
The solid line is the measured sound transmission loss for this specimen. The dashed line is the STC contour fitted to the measured values according to ASTM E413-10. The dotted line (may be above the displayed range) is 10 dB below the flanking limit established for this facility. For any frequency band where the measured transmission loss is above the dotted line, the reported value is potentially limited by flanking transmission via laboratory surfaces, and the true value may be higher than that measured. Bars at the bottom of the graph show deficiencies where the measured data are less than the reference contour as described in the fitting procedure for the STC, defined in ASTM E413-10. The shaded cells in the table and areas in the graph are outside the STC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. The reported values have been corrected according to the procedure outlined in ASTM E90-09. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level, in which case, the corrected values provide an estimate of the lower limit of airborne sound transmission loss.

ASTM E492 Test Results – Normalized Impact Sound Pressure Levels

Client: Nordic Engineered Wood **Test ID:** IIF-15-005

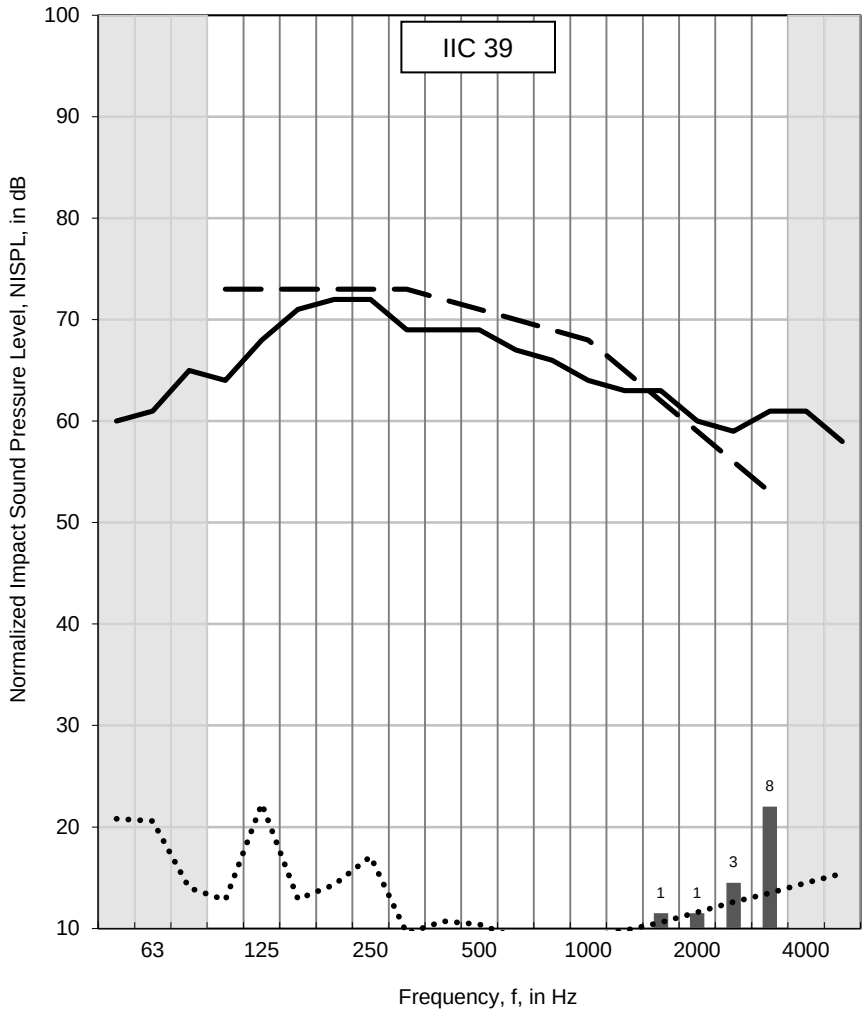
Specimen ID: A1-006070-06F **Date of Test:** February 12, 2015

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Upper	175.3	24.6 to 24.7	34.9 to 39.9
Lower	177.0	18.4 to 18.5	42.4 to 42.5

Area S of test specimen:	17.85 m^2
Mass per unit area:	194 kg/m^2

f (Hz)	NISPL (dB)
50	60
63	61
80	65
100	64
125	68
160	71
200	72
250	72
315	69
400	69
500	69
630	67
800	66
1000	64
1250	63
1600	63
2000	60
2500	59
3150	61
4000	61
5000	58
Impact Insulation Class (IIC)	**39**

Sum of Positive Differences (dB)
13
Max. Positive Difference (dB)
8 dB at 3150 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Measurements of normalized impact sound pressure level (NISPL) were conducted in accordance with the requirements of ASTM E492-09, "Standard Laboratory Measurement of Impact Sound Transmission through Floor-Ceiling Assemblies Using the Tapping Machine".**

In the graph:
The solid line is the measured normalized impact sound pressure level (NISPL) for this specimen. The dashed line is the IIC contour fitted to the measured values according to ASTM E989-06. The dotted line is the background sound level measured in the receiving room during this test (may be below the displayed range). For any frequency where measured NISPL is less than 10 dB above the dotted line, the reported values were adjusted as noted below. Bars at bottom of graph show positive differences; where the measured data are greater than the reference contour as defined in ASTM E989-06. Shaded cells in the table and areas in the graph are outside the IIC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level and the reported values of NISPL provide an estimate of the upper limit of normalized impact sound pressure level, according to the procedure outlined in ASTM E492-09. The reported values of NISPL have been corrected according to the procedure outlined in ASTM E492-09.

Client Nordic Engineered Wood
1100 Ave des Canadiens-de-Montreal
Montreal QC H3B 2S2

Specimen 10 mm floating engineered wood floor placed on a 2 mm closed cell foam on 38 mm (1-1/2") precast concrete slab on 9 mm closed cell foam placed on top of a CLT 5 ply (175 mm).

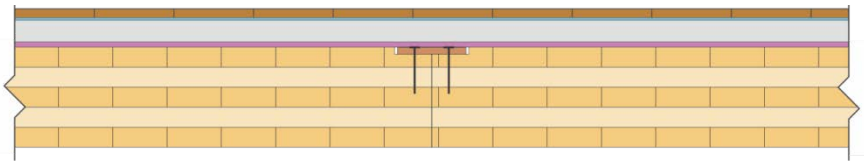
Specimen ID A1-006070-07F

Construction Date: February 13, 2015

Specimen Description

The specimen was composed of two cross-laminated timber (CLT) 5 ply (175 mm thick x 1989 mm wide x 4872 mm long) panels with a butt joint in the middle of the floor. The combined panels filled the entire floor opening of the test frame. The two CLT panels were joined using a 120 mm wide x 12 mm thick plywood strip spanning the full joint (4.9 m). The plywood strip was nailed with common nails 75 mm (3") long spaced 305 mm (12") on centre along the joint with beads of PL premium adhesive between the plywood strip and the CLT panels. The CLT floor was resting on the lip of the test frame and was not fastened to the test frame. The air gaps between the edges of the CLT floor and the test frame were filled with glass fiber insulation and covered with cloth tape. Duct putty was installed around the lower perimeter of the test frame and the CLT.

Engineered floating floor (TORLYS Everest Premier Hardwood – 10 mm thick) with attached cork underlay was installed on top of a 2 mm Roberts® Soft Stride closed cell foam which was placed on top of a 38 mm (1-1/2") precast concrete slab. The 38 mm precast concrete slab was placed on top of 9 mm Owens Corning QuietZone® closed cell foam which was placed on the CLT floor.



Cross-section of A1-006070-07F

Specimen Properties

Element	Actual thickness (mm)	Mass (kg)	Mass/length, area or volume
10 mm TORLYS Everest Premier Hardwood	10	146	7.3 kg/m^2
2 mm Roberts® Soft Stride Closed Cell Foam	2	2.5	0.1 kg/m^2
38 mm Precast Concrete Slab	38	2023	103.0 kg/m^2
9 mm Owens Corning QuietZone® Closed Cell Foam	9	7.5	0.4 kg/m^2
175 mm CLT 5-ply	175	1760	91.0 kg/m^2
Total	**234**	**3942**	**202 kg/m^2**

Test Specimen Installation

- The exposed area of the floor specimen used for the calculations of the airborne sound transmission loss was 17.85 m^2 (4.71 m x 3.79 m).
- The total area of the floor assembly resting on top of the lip was 19.32 m^2 (4.88 m x 3.96 m).
- The mass per area of the elements above the lip was calculated using the total area (19.32 m^2).

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ASTM E90 Test Results – Airborne Sound Transmission Loss

Client: Nordic Engineered Wood **Test ID:** TLF-15-007

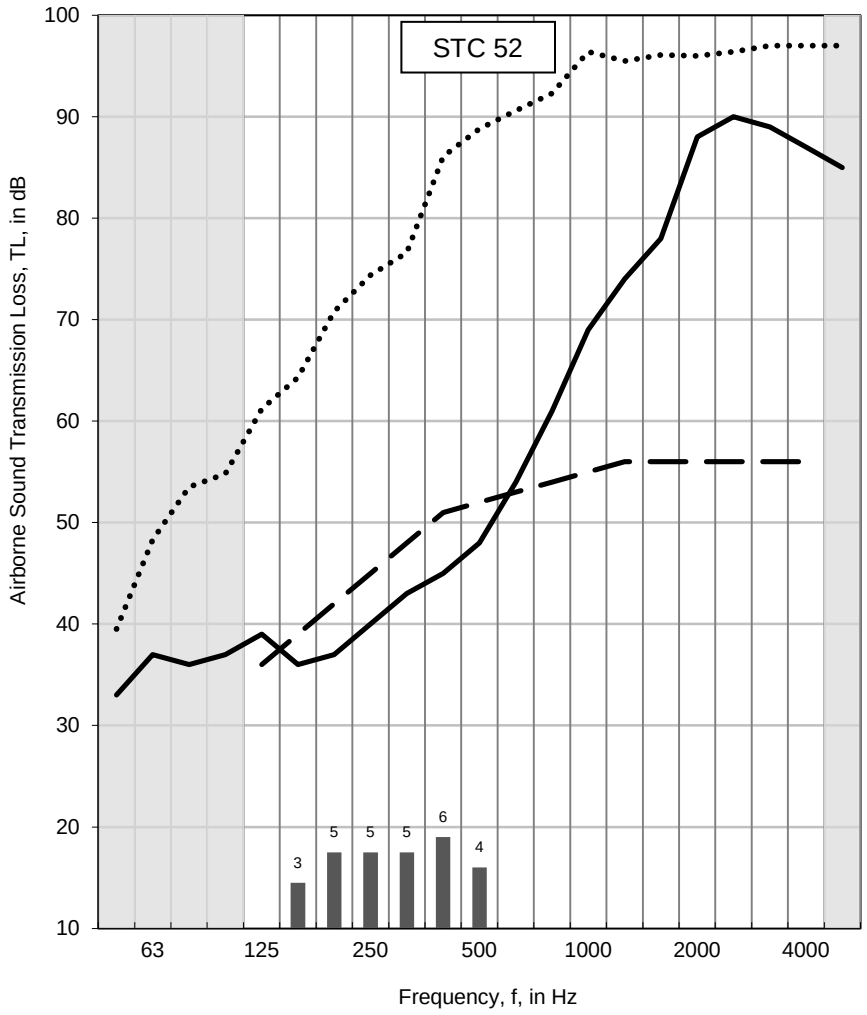
Specimen ID: A1-006070-07F **Date of Test:** February 13, 2015

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Upper	175.0	22.9 to 23.5	34.8 to 35.5
Lower	177.0	18.3 to 18.4	40.8 to 41.1

Area S of test specimen:	17.85 m^2
Mass per unit area:	202 kg/m^2

f (Hz)	Airborne TL (dB)	
50	33	
63	37	
80	36	
100	37	
125	39	
160	36	
200	37	
250	40	
315	43	
400	45	
500	48	
630	54	
800	61	
1000	69	
1250	74	
1600	78	
2000	88	
2500	90	c
3150	89	c
4000	87	
5000	85	
Sound Transmission Class (STC)	**52**	

Sum of Deficiencies (dB)
28
Max. Deficiency (dB)
6 dB at 400 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Airborne sound transmission loss measurements were conducted in accordance with the requirements of ASTM E90-09, "Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements".**

In the graph:
The solid line is the measured sound transmission loss for this specimen. The dashed line is the STC contour fitted to the measured values according to ASTM E413-10. The dotted line (may be above the displayed range) is 10 dB below the flanking limit established for this facility. For any frequency band where the measured transmission loss is above the dotted line, the reported value is potentially limited by flanking transmission via laboratory surfaces, and the true value may be higher than that measured. Bars at the bottom of the graph show deficiencies where the measured data are less than the reference contour as described in the fitting procedure for the STC, defined in ASTM E413-10. The shaded cells in the table and areas in the graph are outside the STC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. The reported values have been corrected according to the procedure outlined in ASTM E90-09. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level, in which case, the corrected values provide an estimate of the lower limit of airborne sound transmission loss.

ASTM E492 Test Results – Normalized Impact Sound Pressure Levels

Client: Nordic Engineered Wood **Test ID:** IIF-15-006

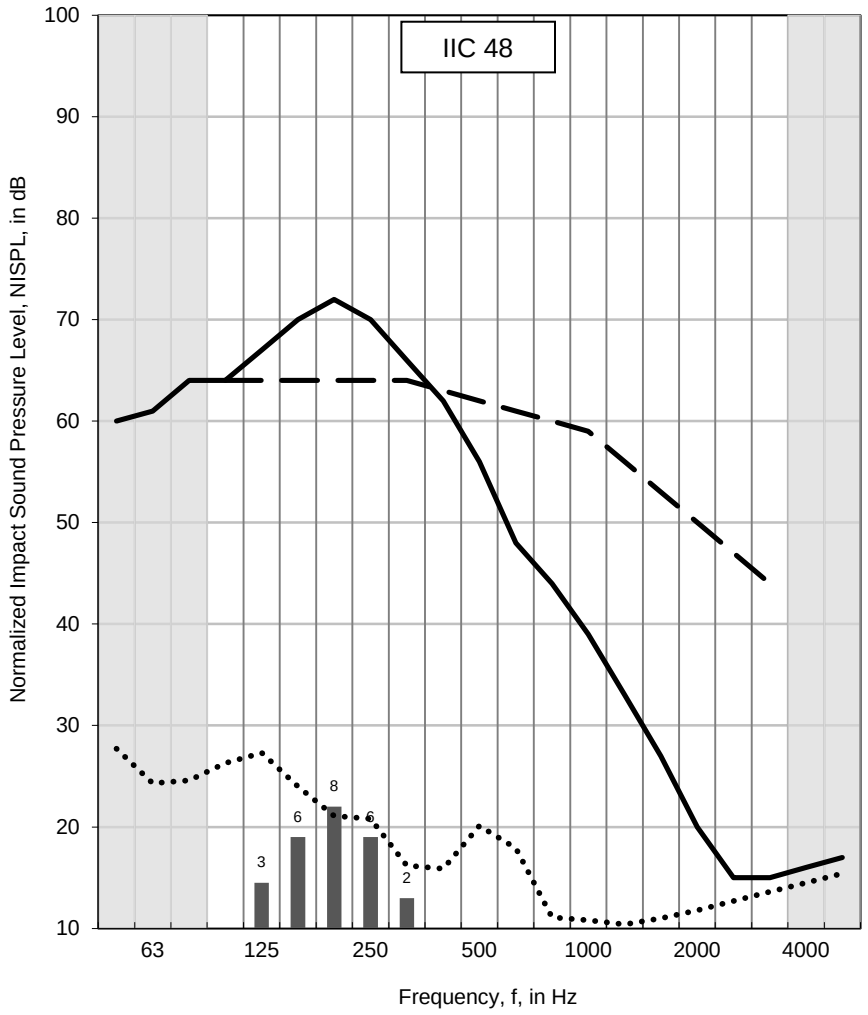
Specimen ID: A1-006070-07F **Date of Test:** February 16, 2015

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Upper	175.0	21.2 to 21.6	30.9 to 32.0
Lower	177.0	17.9 to 18.7	39.4 to 41.1

Area S of test specimen:	17.85 m^2
Mass per unit area:	202 kg/m^2

f (Hz)	NISPL (dB)	
50	60	
63	61	
80	64	
100	64	
125	67	
160	70	
200	72	
250	70	
315	66	
400	62	
500	56	
630	48	
800	44	
1000	39	
1250	33	
1600	27	
2000	20	*
2500	15	*
3150	15	*
4000	16	*
5000	17	*
Impact Insulation Class (IIC)	**48**	

Sum of Positive Differences (dB)
25
Max. Positive Difference (dB)
8 dB at 200 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Measurements of normalized impact sound pressure level (NISPL) were conducted in accordance with the requirements of ASTM E492-09, "Standard Laboratory Measurement of Impact Sound Transmission through Floor-Ceiling Assemblies Using the Tapping Machine".**

In the graph:
The solid line is the measured normalized impact sound pressure level (NISPL) for this specimen. The dashed line is the IIC contour fitted to the measured values according to ASTM E989-06. The dotted line is the background sound level measured in the receiving room during this test (may be below the displayed range). For any frequency where measured NISPL is less than 10 dB above the dotted line, the reported values were adjusted as noted below. Bars at bottom of graph show positive differences; where the measured data are greater than the reference contour as defined in ASTM E989-06. Shaded cells in the table and areas in the graph are outside the IIC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level and the reported values of NISPL provide an estimate of the upper limit of normalized impact sound pressure level, according to the procedure outlined in ASTM E492-09. The reported values of NISPL have been corrected according to the procedure outlined in ASTM E492-09.

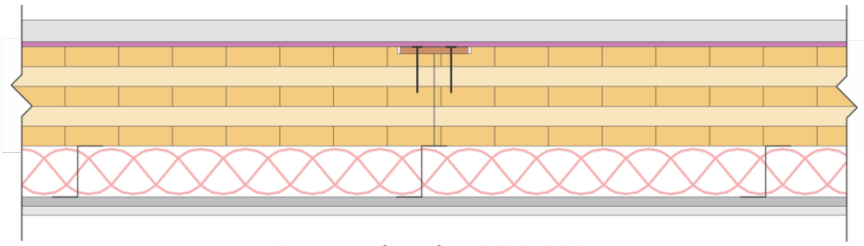
Client	Nordic Engineered Wood 1100 Ave des Canadiens-de-Montreal Montreal QC H3B 2S2
Specimen	38 mm (1-1/2”) precast concrete slab on 9 mm closed cell foam placed on top of a CLT 5 ply (175 mm) with one layer of 16 mm Type X gypsum board installed on Z channels.
Specimen ID	A1-006070-08F
Construction Date:	February 23, 2015 to February 24, 2015

Specimen Description

The specimen was composed of two cross-laminated timber (CLT) 5 ply (175 mm thick x 1989 mm wide x 4872 mm long) panels with a butt joint in the middle of the floor. The combined panels filled the entire floor opening of the test frame. The two CLT panels were joined using a 120 mm wide x 12 mm thick plywood strip spanning the full joint (4.9 m). The plywood strip was nailed with common nails 75 mm (3”) long spaced 305 mm (12”) on centre along the joint with beads of PL premium adhesive between the plywood strip and the CLT panels. The CLT floor was resting on the lip of the test frame and was not fastened to the test frame. The air gaps between the edges of the CLT floor and the test frame were filled with glass fiber insulation and covered with cloth tape. Duct putty was installed around the lower perimeter of the test frame and the CLT.

A 38 mm (1-1/2”) precast concrete slab was placed on 9 mm Owens Corning QuietZone® closed cell foam which was placed on the CLT floor.

For the ceiling sub-assembly, one layer of 16 mm (5/8”) Type X gypsum board was installed on 16 mm (5/8”) furring channels. The layer of gypsum board was attached using 41 mm (1-5/8") long type S screws spaced 305 mm (12”) on centre on every furring channel. Exposed joints were caulked and taped. The furring channels were attached perpendicularly to 90 mm (3-1/2”) Z-channels (26 ga) at a spacing of 406 mm (16”) on centre with two self-tapping screws. The Z-channels were attached to the CLT wall at a spacing of 610 mm (24”) on centre with 92 mm (3-5/8”) Owens Corning EcoTouch Fiberglas® Batts in the cavity.



Cross-section of A1-006070-08F

Specimen Properties

Element	Actual thickness (mm)	Mass (kg)	Mass/length, area or volume
38 mm Precast Concrete Slab	38	2023	103.0 kg/m^2
9 mm Owens Corning QuietZone® Closed Cell Foam	9	7.5	0.4 kg/m^2
175 mm CLT 5-ply	175	1760	91.0 kg/m^2
90 mm Z-channels (26 ga)	90	25	0.8 kg/m
92 mm OC EcoTouch Pink Fiberglas® Batts	92*	29	1.5 kg/m^2
16 mm Furring Channels	16	18	0.4 kg/m
16 mm Type X Gypsum Board	16	196	11.0 kg/m^2
Total	**344**	**4060**	**209 kg/m^2**

***** The thickness of the insulation batts is not included in the total specimen thickness.

Test Specimen Installation

- The exposed area of the floor specimen used for the calculations of the airborne sound transmission loss was 17.85 m^2 (4.71 m x 3.79 m).
- The total area of the floor assembly resting on top of the lip was 19.32 m^2 (4.88 m x 3.96 m).
- The mass per area of the elements above the lip was calculated using the total area (19.32 m^2) and the mass per area of the elements below the lip was calculated using the exposed area (17.85 m^2).

ASTM E90 Test Results – Airborne Sound Transmission Loss

Client: Nordic Engineered Wood **Test ID:** TLF-15-009

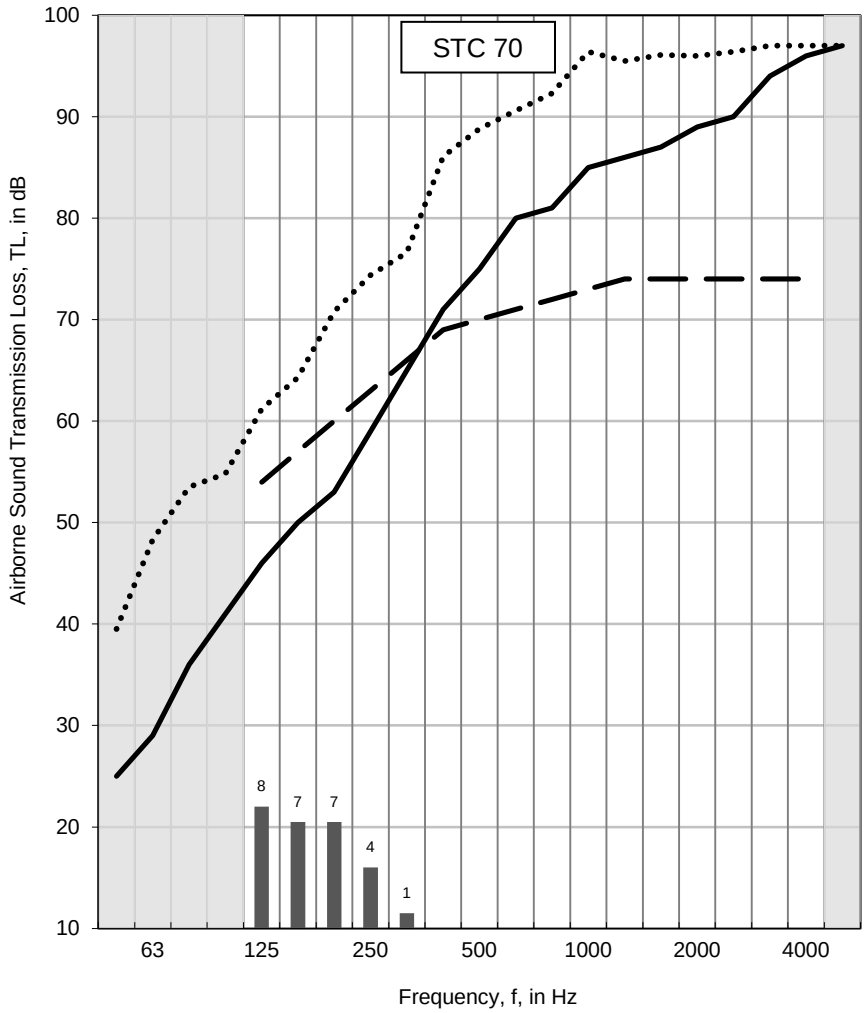
Specimen ID: A1-006070-08F **Date of Test:** February 24, 2015

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Upper	175.3	19.0 to 19.0	34.1 to 34.1
Lower	174.8	15.7 to 15.8	33.9 to 34.2

Area S of test specimen:	17.85 m^2
Mass per unit area:	209 kg/m^2

f (Hz)	Airborne TL (dB)	
50	25	
63	29	
80	36	
100	41	
125	46	
160	50	
200	53	
250	59	
315	65	
400	71	
500	75	c
630	80	c
800	81	
1000	85	
1250	86	
1600	87	
2000	89	c
2500	90	c
3150	94	c
4000	96	*
5000	97	*
Sound Transmission Class (STC)	**70**	

Sum of Deficiencies (dB)
27
Max. Deficiency (dB)
8 dB at 125 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Airborne sound transmission loss measurements were conducted in accordance with the requirements of ASTM E90-09, "Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements" with the exception that the temperature in the lower room was lower than 17ºC.**

In the graph:
The solid line is the measured sound transmission loss for this specimen. The dashed line is the STC contour fitted to the measured values according to ASTM E413-10. The dotted line (may be above the displayed range) is 10 dB below the flanking limit established for this facility. For any frequency band where the measured transmission loss is above the dotted line, the reported value is potentially limited by flanking transmission via laboratory surfaces, and the true value may be higher than that measured. Bars at the bottom of the graph show deficiencies where the measured data are less than the reference contour as described in the fitting procedure for the STC, defined in ASTM E413-10. The shaded cells in the table and areas in the graph are outside the STC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. The reported values have been corrected according to the procedure outlined in ASTM E90-09. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level, in which case, the corrected values provide an estimate of the lower limit of airborne sound transmission loss.

ASTM E492 Test Results – Normalized Impact Sound Pressure Levels

Client: Nordic Engineered Wood **Test ID:** IIF-15-007

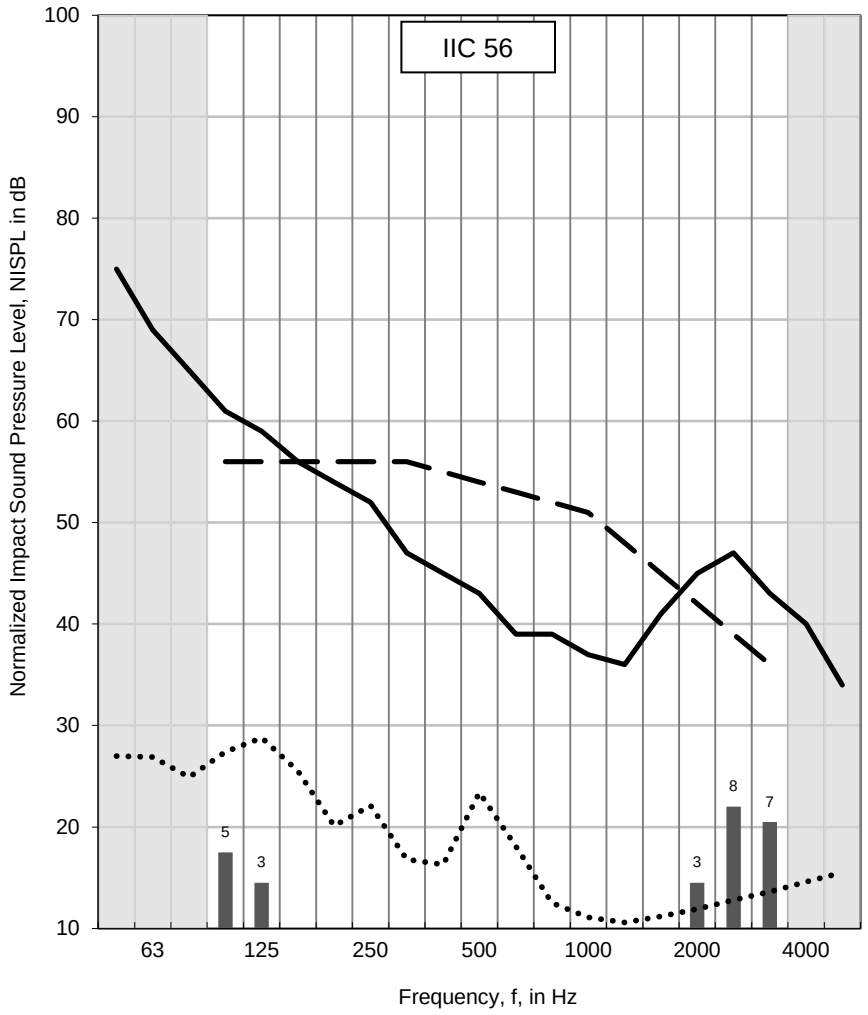
Specimen ID: A1-006070-08F **Date of Test:** February 24, 2015

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Upper	175.3	19.0 to 19.2	33.8 to 35.0
Lower	174.8	15.9 to 16.4	33.9 to 33.9

Area S of test specimen:	17.85 m^2
Mass per unit area:	209 kg/m^2

f (Hz)	NISPL (dB)
50	75
63	69
80	65
100	61
125	59
160	56
200	54
250	52
315	47
400	45
500	43
630	39
800	39
1000	37
1250	36
1600	41
2000	45
2500	47
3150	43
4000	40
5000	34
Impact Insulation Class (IIC)	**56**

Sum of Positive Differences (dB)
26
Max. Positive Difference (dB)
8 dB at 2500 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Measurements of normalized impact sound pressure level (NISPL) were conducted in accordance with the requirements of ASTM E492-09, "Standard Laboratory Measurement of Impact Sound Transmission through Floor-Ceiling Assemblies Using the Tapping Machine" with the exception that the temperature in the lower room was lower than 17ºC.**

In the graph:
The solid line is the measured normalized impact sound pressure level (NISPL) for this specimen. The dashed line is the IIC contour fitted to the measured values according to ASTM E989-06. The dotted line is the background sound level measured in the receiving room during this test (may be below the displayed range). For any frequency where measured NISPL is less than 10 dB above the dotted line, the reported values were adjusted as noted below. Bars at bottom of graph show positive differences; where the measured data are greater than the reference contour as defined in ASTM E989-06. Shaded cells in the table and areas in the graph are outside the IIC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level and the reported values of NISPL provide an estimate of the upper limit of normalized impact sound pressure level, according to the procedure outlined in ASTM E492-09. The reported values of NISPL have been corrected according to the procedure outlined in ASTM E492-09.

Client Nordic Engineered Wood
1100 Ave des Canadiens-de-Montreal
Montreal QC H3B 2S2

Specimen CLT 5 ply (175 mm) with one layer of 16 mm Type X gypsum board installed on Z channels

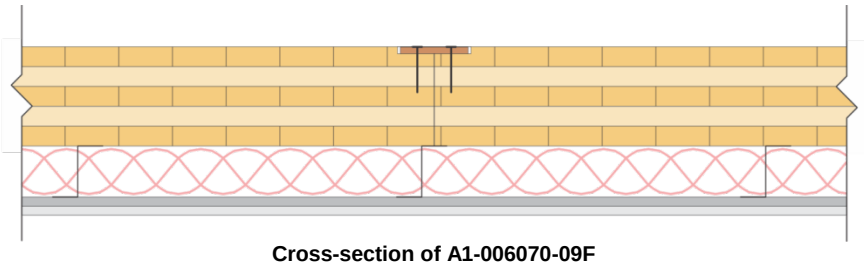
Specimen ID A1-006070-09F

Construction Date: February 25, 2015

Specimen Description

The specimen was composed of two cross-laminated timber (CLT) 5 ply (175 mm thick x 1989 mm wide x 4872 mm long) panels with a butt joint in the middle of the floor. The combined panels filled the entire floor opening of the test frame. The two CLT panels were joined using a 120 mm wide x 12 mm thick plywood strip spanning the full joint (4.9 m). The plywood strip was nailed with common nails 75 mm (3") long spaced 305 mm (12") on centre along the joint with beads of PL premium adhesive between the plywood strip and the CLT panels. The CLT floor was resting on the lip of the test frame and was not fastened to the test frame. The air gaps between the edges of the CLT floor and the test frame were filled with glass fiber insulation and covered with cloth tape. Duct putty was installed around the lower perimeter of the test frame and the CLT.

For the ceiling sub-assembly, one layer of 16 mm (5/8") Type X gypsum board was installed on 16 mm (5/8") furring channels. The layer of gypsum board was attached using 41 mm (1-5/8") long type S screws spaced 305 mm (12") on centre on every furring channel. Exposed joints were caulked and taped. The furring channels were attached perpendicularly to 90 mm (3-1/2") Z-channels (26 ga) at a spacing of 406 mm (16") on centre with two self-tapping screws. The Z-channels were attached to the CLT wall at a spacing of 610 mm (24") on centre with 92 mm (3-5/8") Owens Corning EcoTouch Fiberglas® Batts in the cavity.



Cross-section of A1-006070-09F

Specimen Properties

Element	Actual thickness (mm)	Mass (kg)	Mass/length, area or volume
175 mm CLT 5-ply	175	1760	91.0 kg/m^2
90 mm Z-channels (26 ga)	90	25	0.8 kg/m
92 mm OC EcoTouch Pink Fiberglas® Batts	92*	29	1.5 kg/m^2
16 mm Furring Channels	16	18	0.4 kg/m
16 mm Type X Gypsum Board	16	196	11.0 kg/m^2
Total	**297**	**2028**	**106 kg/m^2**

***** The thickness of the insulation batts is not included in the total specimen thickness.

Test Specimen Installation

- The exposed area of the floor specimen used for the calculations of the airborne sound transmission loss was 17.85 m^2 (4.71 m x 3.79 m).
- The total area of the floor assembly resting on top of the lip was 19.32 m^2 (4.88 m x 3.96 m).
- The mass per area of the elements above the lip was calculated using the total area (19.32 m^2) and the mass per area of the elements below the lip was calculated using the exposed area (17.85 m^2).

ASTM E90 Test Results – Airborne Sound Transmission Loss

Client: Nordic Engineered Wood **Test ID:** TLF-15-010

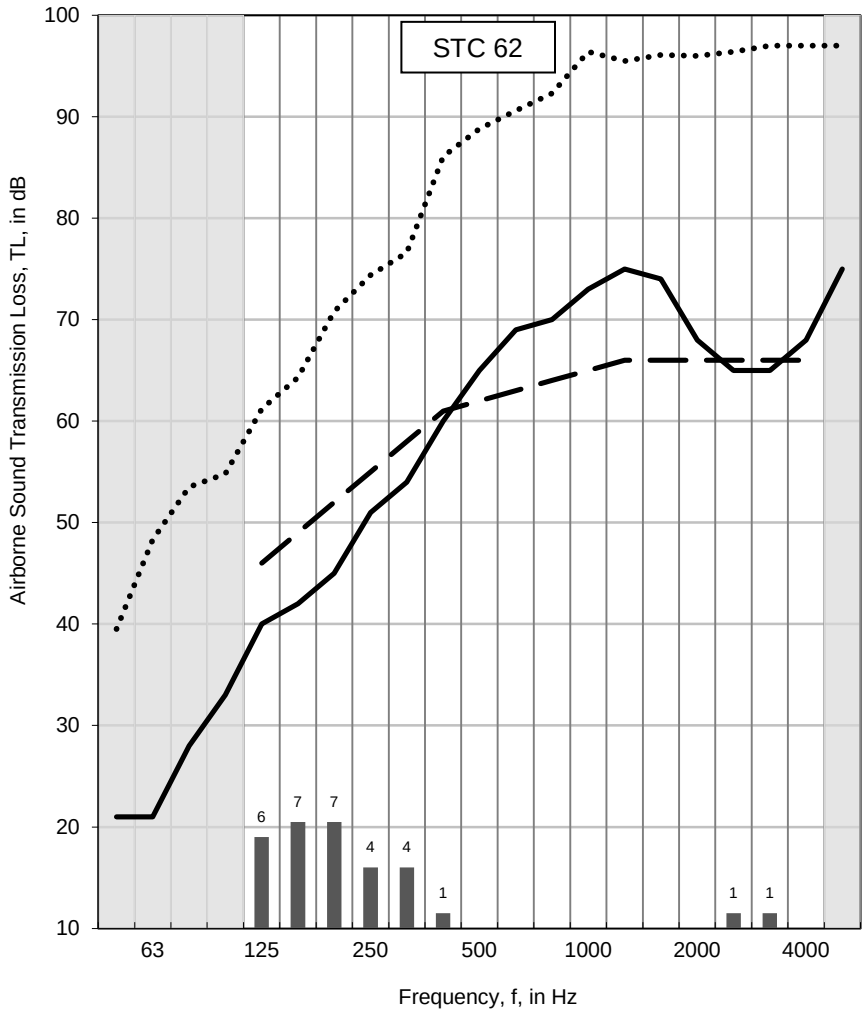
Specimen ID: A1-006070-09F **Date of Test:** February 25, 2015

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Upper	176.2	19.9 to 20.0	34.5 to 34.7
Lower	174.8	15.7 to 15.8	38.7 to 39.2

Area S of test specimen:	17.85 m^2
Mass per unit area:	106 kg/m^2

f (Hz)	Airborne TL (dB)
50	21
63	21
80	28
100	33
125	40
160	42
200	45
250	51
315	54
400	60
500	65
630	69
800	70
1000	73
1250	75
1600	74
2000	68
2500	65
3150	65
4000	68
5000	75
Sound Transmission Class (STC)	**62**

Sum of Deficiencies (dB)
31
Max. Deficiency (dB)
7 dB at 160 and 200 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Airborne sound transmission loss measurements were conducted in accordance with the requirements of ASTM E90-09, "Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements" with the exception that the temperature in the lower room was lower than 17ºC.**

In the graph:
The solid line is the measured sound transmission loss for this specimen. The dashed line is the STC contour fitted to the measured values according to ASTM E413-10. The dotted line (may be above the displayed range) is 10 dB below the flanking limit established for this facility. For any frequency band where the measured transmission loss is above the dotted line, the reported value is potentially limited by flanking transmission via laboratory surfaces, and the true value may be higher than that measured. Bars at the bottom of the graph show deficiencies where the measured data are less than the reference contour as described in the fitting procedure for the STC, defined in ASTM E413-10. The shaded cells in the table and areas in the graph are outside the STC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. The reported values have been corrected according to the procedure outlined in ASTM E90-09. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level, in which case, the corrected values provide an estimate of the lower limit of airborne sound transmission loss.

ASTM E492 Test Results – Normalized Impact Sound Pressure Levels

Client: Nordic Engineered Wood **Test ID:** IIF-15-008

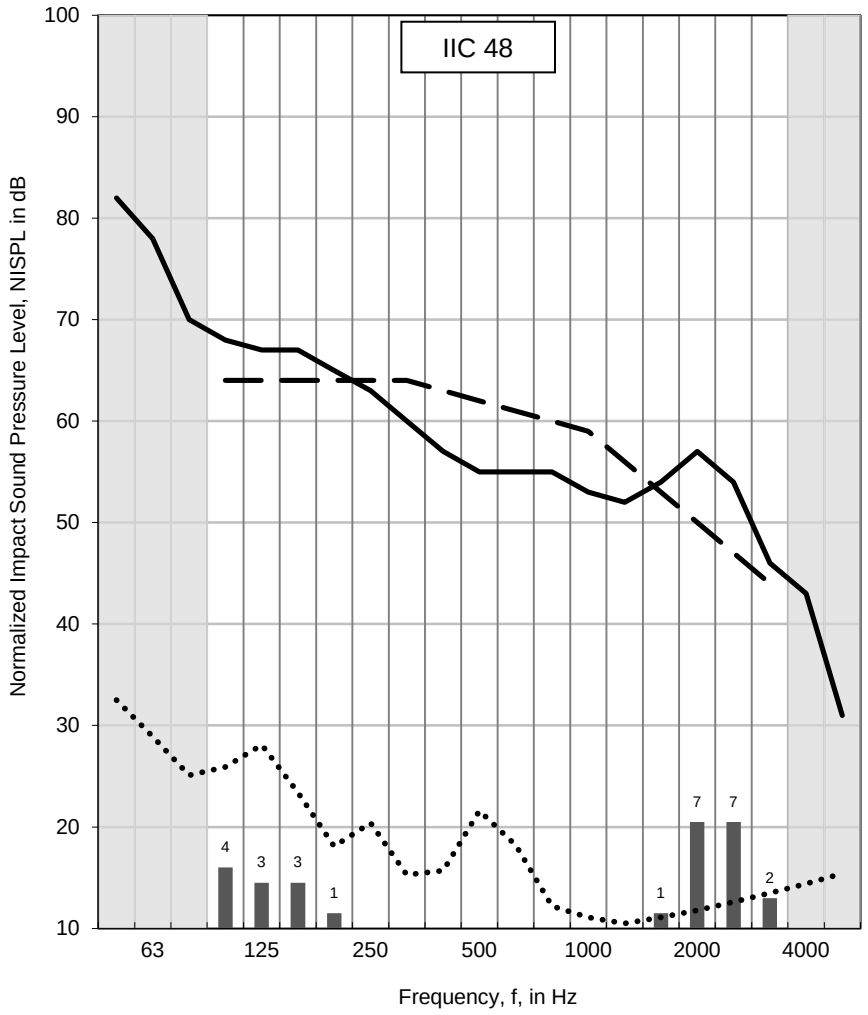
Specimen ID: A1-006070-09F **Date of Test:** February 25, 2015

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Upper	176.2	20.4 to 20.6	32.9 to 34.4
Lower	174.8	16.2 to 17.7	39.0 to 40.0

Area S of test specimen:	17.85 m^2
Mass per unit area:	106 kg/m^2

f (Hz)	NISPL (dB)	
50	82	
63	78	
80	70	
100	68	
125	67	
160	67	
200	65	
250	63	
315	60	
400	57	
500	55	
630	55	
800	55	
1000	53	
1250	52	
1600	54	
2000	57	
2500	54	
3150	46	
4000	43	
5000	31	c
Impact Insulation Class (IIC)	**48**	

Sum of Positive Differences (dB)
28
Max. Positive Difference (dB)
7 dB at 2000 and 2500 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Measurements of normalized impact sound pressure level (NISPL) were conducted in accordance with the requirements of ASTM E492-09, "Standard Laboratory Measurement of Impact Sound Transmission through Floor-Ceiling Assemblies Using the Tapping Machine" with the exception that the temperature in the lower room was lower than 17ºC.**

In the graph:
The solid line is the measured normalized impact sound pressure level (NISPL) for this specimen. The dashed line is the IIC contour fitted to the measured values according to ASTM E989-06. The dotted line is the background sound level measured in the receiving room during this test (may be below the displayed range). For any frequency where measured NISPL is less than 10 dB above the dotted line, the reported values were adjusted as noted below. Bars at bottom of graph show positive differences; where the measured data are greater than the reference contour as defined in ASTM E989-06. Shaded cells in the table and areas in the graph are outside the IIC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level and the reported values of NISPL provide an estimate of the upper limit of normalized impact sound pressure level, according to the procedure outlined in ASTM E492-09. The reported values of NISPL have been corrected according to the procedure outlined in ASTM E492-09.

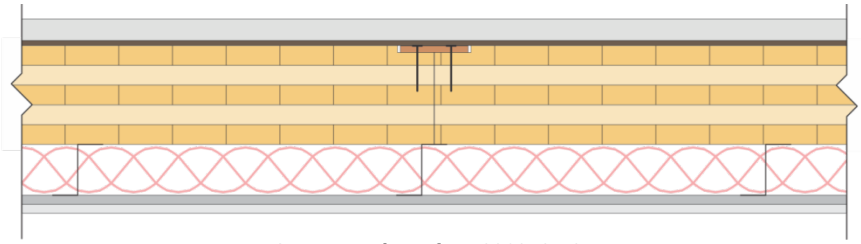
Client	Nordic Engineered Wood 1100 Ave des Canadiens-de-Montreal Montreal QC H3B 2S2
Specimen	38 mm (1-1/2”) precast concrete slab on 10 mm tar boards placed on top of a CLT 5 ply (175 mm) with one layer of 16 mm Type X gypsum board installed on Z channels.
Specimen ID	A1-006070-10F
Construction Date:	February 25, 2015

Specimen Description

The specimen was composed of two cross-laminated timber (CLT) 5 ply (175 mm thick x 1989 mm wide x 4872 mm long) panels with a butt joint in the middle of the floor. The combined panels filled the entire floor opening of the test frame. The two CLT panels were joined using a 120 mm wide x 12 mm thick plywood strip spanning the full joint (4.9 m). The plywood strip was nailed with common nails 75 mm (3”) long spaced 305 mm (12”) on centre along the joint with beads of PL premium adhesive between the plywood strip and the CLT panels. The CLT floor was resting on the lip of the test frame and was not fastened to the test frame. The air gaps between the edges of the CLT floor and the test frame were filled with glass fiber insulation and covered with cloth tape. Duct putty was installed around the lower perimeter of the test frame and the CLT.

A 38 mm (1-1/2”) precast concrete slab was placed on 10 mm tar boards which was placed on the CLT floor.

For the ceiling sub-assembly, one layer of 16 mm (5/8”) Type X gypsum board was installed on 16 mm (5/8”) furring channels. The layer of gypsum board was attached using 41 mm (1-5/8") long type S screws spaced 305 mm (12”) on centre on every furring channel. Exposed joints were caulked and taped. The furring channels were attached perpendicularly to 90 mm (3-1/2”) Z-channels (26 ga) at a spacing of 406 mm (16”) on centre with two self-tapping screws. The Z-channels were attached to the CLT wall at a spacing of 610 mm (24”) on centre with 92 mm (3-5/8”) Owens Corning EcoTouch Fiberglas® Batts in the cavity.



Cross-section of A1-006070-10F

Specimen Properties

Element	Actual thickness (mm)	Mass (kg)	Mass/length, area or volume
38 mm Precast Concrete Slab	38	2023	103.0 kg/m^2
10 mm Tar Board (Building Products)	10	56	2.8 kg/m^2
175 mm CLT 5-ply	175	1760	91.0 kg/m^2
90 mm Z-channels (26 ga)	90	25	0.8 kg/m
92 mm OC EcoTouch Pink Fiberglas® Batts	92*	29	1.5 kg/m^2
16 mm Furring Channels	16	18	0.4 kg/m
16 mm Type X Gypsum Board	16	196	11.0 kg/m^2
Total	**345**	**4107**	**213 kg/m^2**

***** The thickness of the insulation batts is not included in the total specimen thickness.

Test Specimen Installation

- The exposed area of the floor specimen used for the calculations of the airborne sound transmission loss was 17.85 m^2 (4.71 m x 3.79 m).
- The total area of the floor assembly resting on top of the lip was 19.32 m^2 (4.88 m x 3.96 m).
- The mass per area of the elements above the lip was calculated using the total area (19.32 m^2) and the mass per area of the elements below the lip was calculated using the exposed area (17.85 m^2).

ASTM E90 Test Results – Airborne Sound Transmission Loss

Client: Nordic Engineered Wood **Test ID:** TLF-15-013

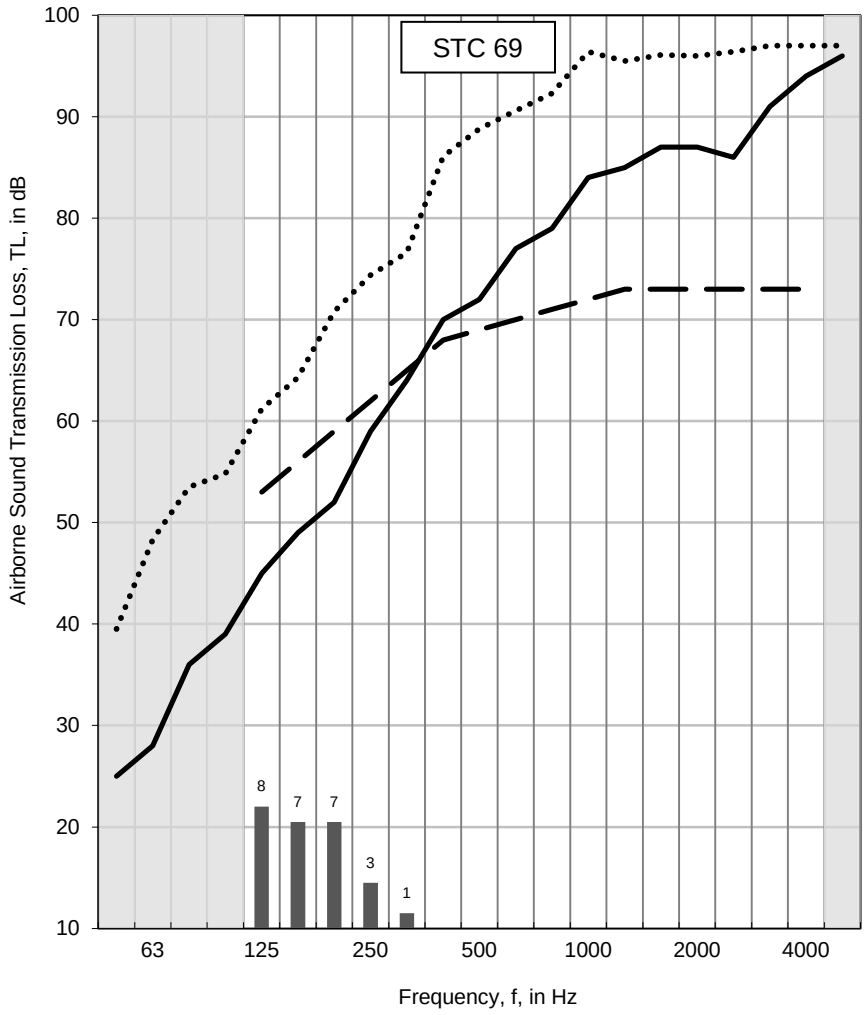
Specimen ID: A1-006070-10F **Date of Test:** February 26, 2015

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Upper	175.3	22.4 to 23.4	35.3 to 36.5
Lower	174.8	17.0 to 18.2	34.0 to 36.7

Area S of test specimen:	17.85 m^2
Mass per unit area:	213 kg/m^2

f (Hz)	Airborne TL (dB)
50	25
63	28
80	36
100	39
125	45
160	49
200	52
250	59
315	64
400	70
500	72
630	77
800	79
1000	84
1250	85
1600	87
2000	87
2500	86
3150	91
4000	94
5000	96
Sound Transmission Class (STC)	**69**

Sum of Deficiencies (dB)
26
Max. Deficiency (dB)
8 dB at 125 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Airborne sound transmission loss measurements were conducted in accordance with the requirements of ASTM E90-09, "Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements".**

In the graph:
The solid line is the measured sound transmission loss for this specimen. The dashed line is the STC contour fitted to the measured values according to ASTM E413-10. The dotted line (may be above the displayed range) is 10 dB below the flanking limit established for this facility. For any frequency band where the measured transmission loss is above the dotted line, the reported value is potentially limited by flanking transmission via laboratory surfaces, and the true value may be higher than that measured. Bars at the bottom of the graph show deficiencies where the measured data are less than the reference contour as described in the fitting procedure for the STC, defined in ASTM E413-10. The shaded cells in the table and areas in the graph are outside the STC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. The reported values have been corrected according to the procedure outlined in ASTM E90-09. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level, in which case, the corrected values provide an estimate of the lower limit of airborne sound transmission loss.

ASTM E492 Test Results – Normalized Impact Sound Pressure Levels

Client: Nordic Engineered Wood **Test ID:** IIF-15-009

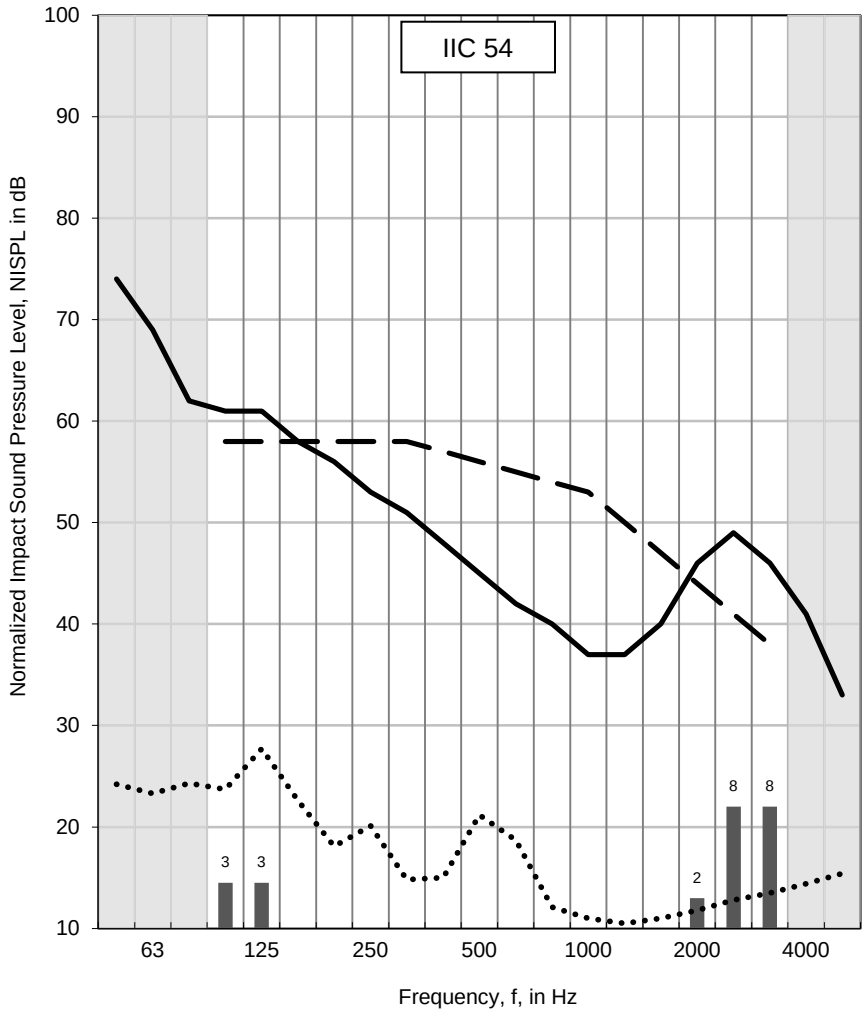
Specimen ID: A1-006070-10F **Date of Test:** February 25, 2015

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Upper	175.3	21.2 to 21.3	29.2 to 29.7
Lower	174.8	16.6 to 16.7	37.1 to 37.2

Area S of test specimen:	17.85 m^2
Mass per unit area:	213 kg/m^2

f (Hz)	NISPL (dB)
50	74
63	69
80	62
100	61
125	61
160	58
200	56
250	53
315	51
400	48
500	45
630	42
800	40
1000	37
1250	37
1600	40
2000	46
2500	49
3150	46
4000	41
5000	33
Impact Insulation Class (IIC)	**54**

Sum of Positive Differences (dB)
24
Max. Positive Difference (dB)
8 dB at 2500 and 3150 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Measurements of normalized impact sound pressure level (NISPL) were conducted in accordance with the requirements of ASTM E492-09, "Standard Laboratory Measurement of Impact Sound Transmission through Floor-Ceiling Assemblies Using the Tapping Machine" with the exception that the temperature in the lower room was lower than 17ºC.**

In the graph:
The solid line is the measured normalized impact sound pressure level (NISPL) for this specimen. The dashed line is the IIC contour fitted to the measured values according to ASTM E989-06. The dotted line is the background sound level measured in the receiving room during this test (may be below the displayed range). For any frequency where measured NISPL is less than 10 dB above the dotted line, the reported values were adjusted as noted below. Bars at bottom of graph show positive differences; where the measured data are greater than the reference contour as defined in ASTM E989-06. Shaded cells in the table and areas in the graph are outside the IIC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level and the reported values of NISPL provide an estimate of the upper limit of normalized impact sound pressure level, according to the procedure outlined in ASTM E492-09. The reported values of NISPL have been corrected according to the procedure outlined in ASTM E492-09.

Client Nordic Engineered Wood
1100 Ave des Canadiens-de-Montreal
Montreal QC H3B 2S2

Specimen ***PAL, type 3***

Engineered wood covering on 38 mm (1-1/2”) precast concrete slab on 10 mm tar boards placed on top of a CLT 5 ply (175 mm) with one layer of 16 mm Type X gypsum board installed on Z channels.

Specimen ID A1-006070-11F

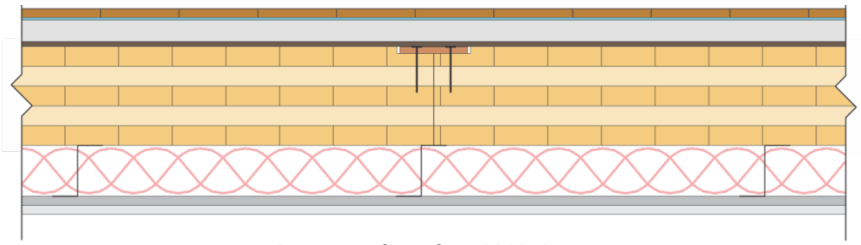
Construction Date: February 26, 2015

Specimen Description

The specimen was composed of two cross-laminated timber (CLT) 5 ply (175 mm thick x 1989 mm wide x 4872 mm long) panels with a butt joint in the middle of the floor. The combined panels filled the entire floor opening of the test frame. The two CLT panels were joined using a 120 mm wide x 12 mm thick plywood strip spanning the full joint (4.9 m). The plywood strip was nailed with common nails 75 mm (3”) long spaced 305 mm (12”) on centre along the joint with beads of PL premium adhesive between the plywood strip and the CLT panels. The CLT floor was resting on the lip of the test frame and was not fastened to the test frame. The air gaps between the edges of the CLT floor and the test frame were filled with glass fiber insulation and covered with cloth tape. Duct putty was installed around the lower perimeter of the test frame and the CLT.

Engineered floating floor (TORLYS Everest Premier Hardwood – 10 mm thick) with attached cork underlay was installed on top of a 2 mm Roberts® Soft Stride closed cell foam which was placed on top of a 38 mm (1-1/2”) precast concrete slab. The 38 mm precast concrete slab was placed on top of 10 mm tar boards which was placed on the CLT floor.

For the ceiling sub-assembly, one layer of 16 mm (5/8”) Type X gypsum board was installed on 16 mm (5/8”) furring channels. The layer of gypsum board was attached using 41 mm (1-5/8") long type S screws spaced 305 mm (12”) on centre on every furring channel. Exposed joints were caulked and taped. The furring channels were attached perpendicularly to 90 mm (3-1/2”) Z-channels (26 ga) at a spacing of 406 mm (16”) on centre with two self-tapping screws. The Z-channels were attached to the CLT wall at a spacing of 610 mm (24”) on centre with 92 mm (3-5/8”) Owens Corning EcoTouch Fiberglas® Batts in the cavity.



Cross-section of A1-006070-11F

Specimen Properties

Element	Actual thickness (mm)	Mass (kg)	Mass/length, area or volume
10 mm Torlys Everest Premier Harwood	10	141	7.3 kg/m^2
2 mm Roberts® Soft Stride	2	2	0.1 kg/m^2
38 mm Precast Concrete Slab	38	2023	103.0 kg/m^2
10 mm Tarboard	10	56	2.8 kg/m^2
175 mm CLT 5-ply	175	1760	91.0 kg/m^2
90 mm Z-channels (26 ga)	90	25	0.8 kg/m
92 mm OC EcoTouch Pink Fiberglas® Batts	92*	29	1.5 kg/m^2
16 mm Furring Channels	16	18	0.4 kg/m
16 mm Type X Gypsum Board	16	196	11.0 kg/m^2
Total	**357**	**4250**	**219 kg/m^2**

***** The thickness of the insulation batts is not included in the total specimen thickness.

Test Specimen Installation

- The exposed area of the floor specimen used for the calculations of the airborne sound transmission loss was 17.85 m^2 (4.71 m x 3.79 m).
- The total area of the floor assembly resting on top of the lip was 19.32 m^2 (4.88 m x 3.96 m).
- The mass per area of the elements above the lip was calculated using the total area (19.32 m^2) and the mass per area of the elements below the lip was calculated using the exposed area (17.85 m^2).

ASTM E90 Test Results – Airborne Sound Transmission Loss

Client: Nordic Engineered Wood **Test ID:** TLF-15-012

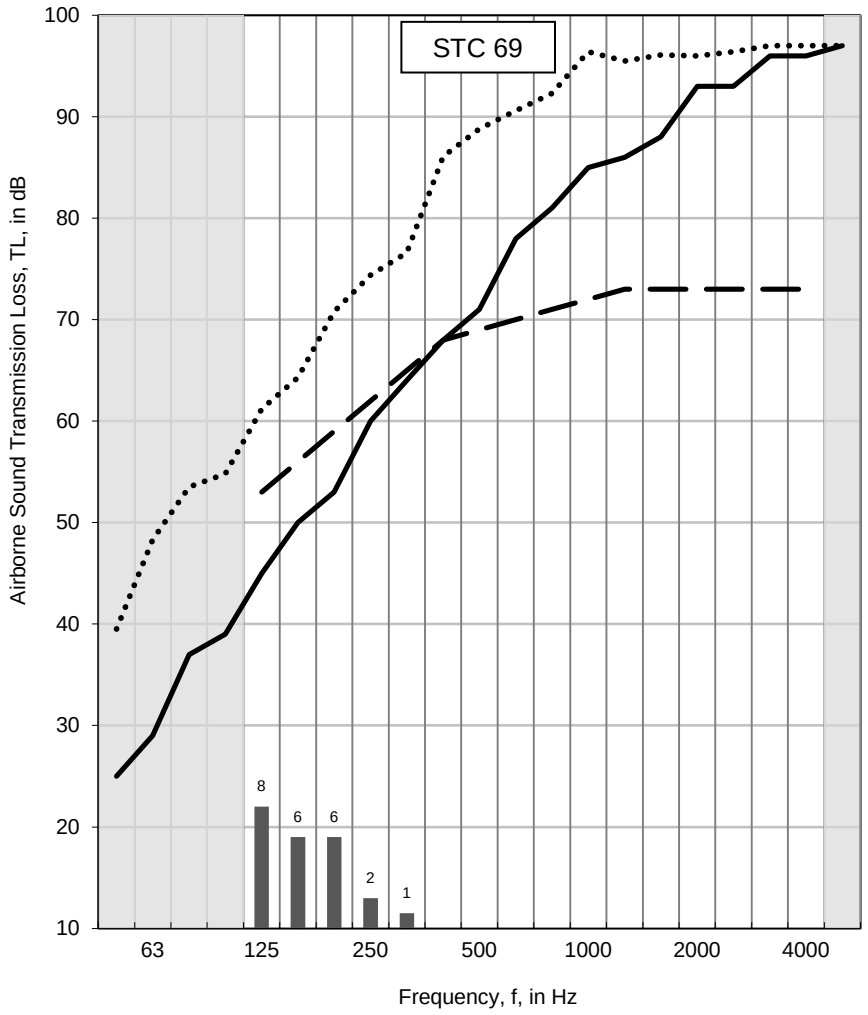
Specimen ID: A1-006070-11F **Date of Test:** February 26, 2015

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Upper	175.0	22.8 to 22.9	34.2 to 34.6
Lower	174.8	16.9 to 16.9	36.9 to 37.1

Area S of test specimen:	17.85 m^2
Mass per unit area:	219 kg/m^2

f (Hz)	Airborne TL (dB)	
50	25	
63	29	
80	37	
100	39	
125	45	
160	50	
200	53	
250	60	
315	64	
400	68	
500	71	c
630	78	c
800	81	
1000	85	
1250	86	
1600	88	
2000	93	c
2500	93	c
3150	96	*
4000	96	*
5000	97	*
Sound Transmission Class (STC)	**69**	

Sum of Deficiencies (dB)
23
Max. Deficiency (dB)
8 dB at 125 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Airborne sound transmission loss measurements were conducted in accordance with the requirements of ASTM E90-09, "Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements" with the exception that the temperature in the lower room was lower than 17ºC.**

In the graph:
The solid line is the measured sound transmission loss for this specimen. The dashed line is the STC contour fitted to the measured values according to ASTM E413-10. The dotted line (may be above the displayed range) is 10 dB below the flanking limit established for this facility. For any frequency band where the measured transmission loss is above the dotted line, the reported value is potentially limited by flanking transmission via laboratory surfaces, and the true value may be higher than that measured. Bars at the bottom of the graph show deficiencies where the measured data are less than the reference contour as described in the fitting procedure for the STC, defined in ASTM E413-10. The shaded cells in the table and areas in the graph are outside the STC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. The reported values have been corrected according to the procedure outlined in ASTM E90-09. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level, in which case, the corrected values provide an estimate of the lower limit of airborne sound transmission loss.

ASTM E492 Test Results – Normalized Impact Sound Pressure Levels

Client: Nordic Engineered Wood **Test ID:** IIF-15-010

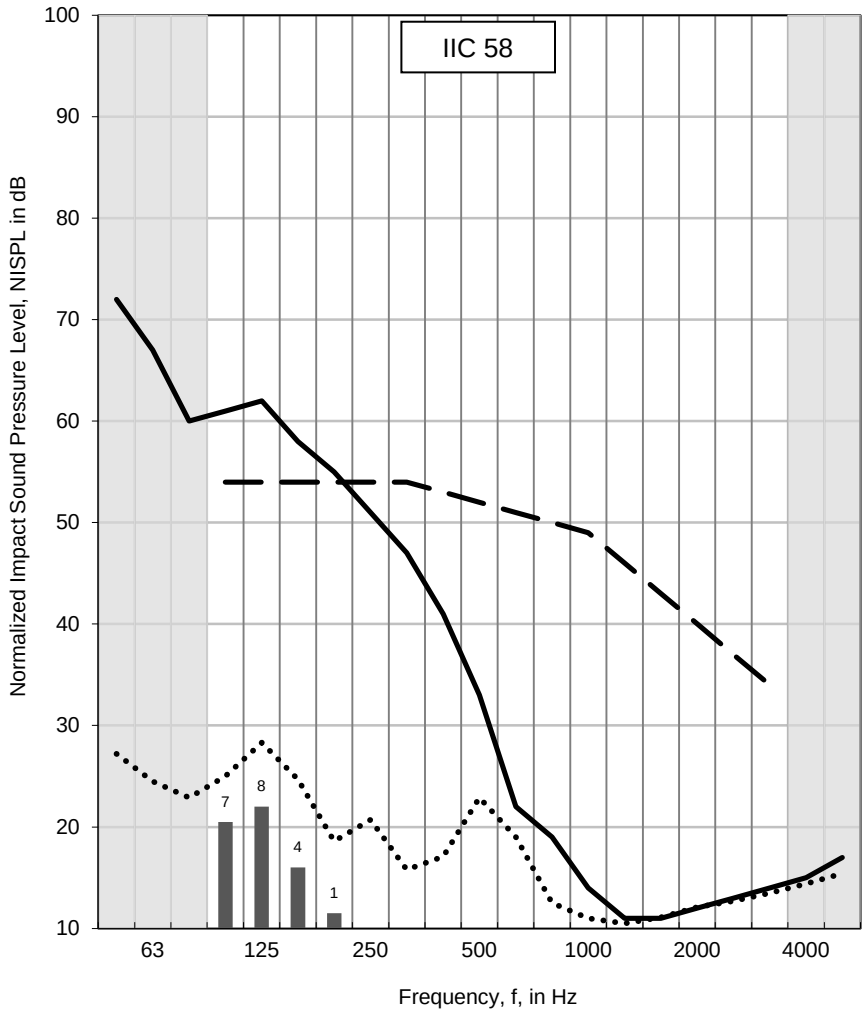
Specimen ID: A1-006070-11F **Date of Test:** February 26, 2015

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Upper	175.0	22.5 to 22.6	34.8 to 36.7
Lower	174.8	17.0 to 17.1	36.1 to 36.6

Area S of test specimen:	17.85 m^2
Mass per unit area:	219 kg/m^2

f (Hz)	NISPL (dB)	
50	72	
63	67	
80	60	
100	61	
125	62	
160	58	
200	55	
250	51	
315	47	
400	41	
500	33	c
630	22	*
800	19	c
1000	14	*
1250	11	*
1600	11	*
2000	12	*
2500	13	*
3150	14	*
4000	15	*
5000	17	*
Impact Insulation Class (IIC)	**58**	

Sum of Positive Differences (dB)
20
Max. Positive Difference (dB)
8 dB at 125 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Measurements of normalized impact sound pressure level (NISPL) were conducted in accordance with the requirements of ASTM E492-09, "Standard Laboratory Measurement of Impact Sound Transmission through Floor-Ceiling Assemblies Using the Tapping Machine".**

In the graph:
The solid line is the measured normalized impact sound pressure level (NISPL) for this specimen. The dashed line is the IIC contour fitted to the measured values according to ASTM E989-06. The dotted line is the background sound level measured in the receiving room during this test (may be below the displayed range). For any frequency where measured NISPL is less than 10 dB above the dotted line, the reported values were adjusted as noted below. Bars at bottom of graph show positive differences; where the measured data are greater than the reference contour as defined in ASTM E989-06. Shaded cells in the table and areas in the graph are outside the IIC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level and the reported values of NISPL provide an estimate of the upper limit of normalized impact sound pressure level, according to the procedure outlined in ASTM E492-09. The reported values of NISPL have been corrected according to the procedure outlined in ASTM E492-09.

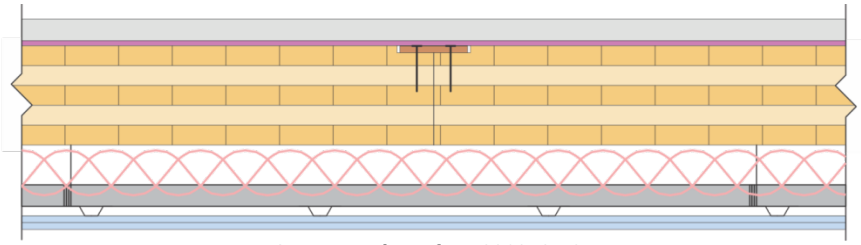
Client	Nordic Engineered Wood 1100 Ave des Canadiens-de-Montreal Montreal QC H3B 2S2
Specimen	38 mm (1-1/2”) precast concrete slab on 9 mm closed cell foam placed on top of a CLT 5 ply (175 mm) with two layers of 13 mm Type C gypsum board installed on a hung ceiling grid.
Specimen ID	A1-006070-12F
Construction Date:	February 27, 2015

Specimen Description

The specimen was composed of two cross-laminated timber (CLT) 5 ply (175 mm thick x 1989 mm wide x 4872 mm long) panels with a butt joint in the middle of the floor. The combined panels filled the entire floor opening of the test frame. The two CLT panels were joined using a 120 mm wide x 12 mm thick plywood strip spanning the full joint (4.9 m). The plywood strip was nailed with common nails 75 mm (3”) long spaced 305 mm (12”) on centre along the joint with beads of PL premium adhesive between the plywood strip and the CLT panels. The CLT floor was resting on the lip of the test frame and was not fastened to the test frame. The air gaps between the edges of the CLT floor and the test frame were filled with glass fiber insulation and covered with cloth tape. Duct putty was installed around the lower perimeter of the test frame and the CLT.

A 38 mm (1-1/2”) precast concrete slab was placed on 9 mm Owens Corning QuietZone® closed cell foam which was placed on the CLT floor.

For the hung ceiling, two layers of 13 mm (5/8”) Type C gypsum board were installed on 22 mm (7/8”) furring channels. The base layer of gypsum board was attached using 41 mm (1-5/8") long type S screws spaced 305 mm (12”) on centre on every furring channel. The face layer was staggered from the base later and attached using 50 mm (2") long type S screws spaced 305 mm (12”) on centre on every furring channel. The exposed gypsum board joints were caulked and taped. The furring channels were attached perpendicularly to the 38 mm (1-1/2”) C-channels at a spacing of 406 mm (16”) on centre with wire. The C-channels were attached to the CLT using standard ceiling wire and angles which were screwed into the CLT. The C-channels were spaced 1220 mm (4’) on centre and hung with a space of 65 mm (2-1/2”) from the top of the C-channels to the underside the CLT with 92 mm (3-5/8”) Owens Corning EcoTouch Fiberglas® Batts in the cavity. The total hung ceiling depth was 150 mm (6”).



Cross-section of A1-006070-12F

Specimen Properties

Element	Actual thickness (mm)	Mass (kg)	Mass/length, area or volume
38 mm Precast Concrete Slab	38	2023	103.0 kg/m^2
9 mm Owens Corning QuietZone® Closed Cell Foam	9	8	0.4 kg/m^2
175 mm CLT 5-ply	175	1760	91.0 kg/m^2
Standard Ceiling Wire + Angles	65	-	- -
92 mm OC EcoTouch Pink Fiberglas® Batts	92*	29	1.5 kg/m^2
38 mm (1-1/2") C-Channels	38	9	0.5 kg/m
22 mm (7/8”) Furring Channels	22	9	0.2 kg/m
13 mm (1/2”) CertainTeed Type C Gypsum Board	13	137	7.7 kg/m^2
13 mm (1/2”) CertainTeed Type C Gypsum Board	13	137	7.7 kg/m^2
Total	**373**	**4112**	**212 kg/m^2**

***** The thickness of the insulation batts is not included in the total specimen thickness.

Test Specimen Installation

- The exposed area of the floor specimen used for the calculations of the airborne sound transmission loss was 17.85 m^2 (4.71 m x 3.79 m).
- The total area of the floor assembly resting on top of the lip was 19.32 m^2 (4.88 m x 3.96 m).
- The mass per area of the elements above the lip was calculated using the total area (19.32 m^2) and the mass per area of the elements below the lip was calculated using the exposed area (17.85 m^2).

ASTM E90 Test Results – Airborne Sound Transmission Loss

Client: Nordic Engineered Wood **Test ID:** TLF-15-014

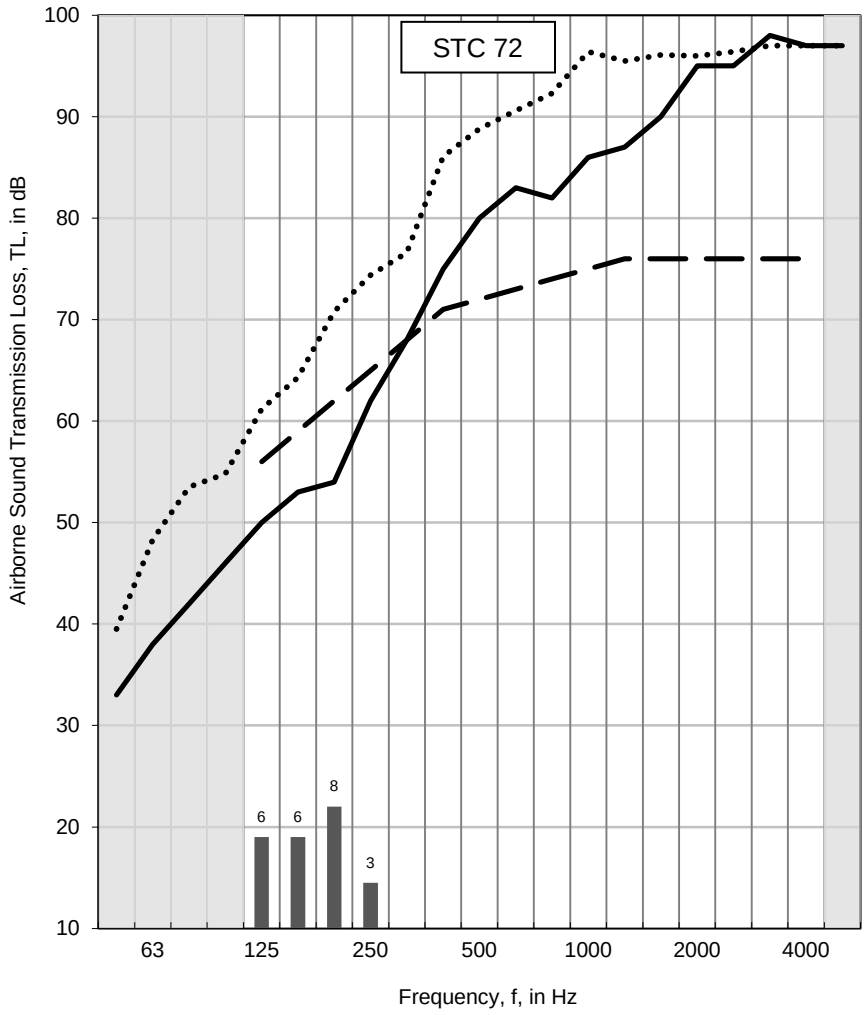
Specimen ID: A1-006070-12F **Date of Test:** March 2, 2015

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Upper	175.3	21.6 to 21.7	34.6 to 34.8
Lower	174.3	19.2 to 19.4	40.3 to 40.6

Area S of test specimen:	17.85 m^2
Mass per unit area:	212 kg/m^2

f (Hz)	Airborne TL (dB)	
50	33	
63	38	
80	42	
100	46	
125	50	
160	53	
200	54	
250	62	
315	68	
400	75	
500	80	c
630	83	c
800	82	
1000	86	
1250	87	c
1600	90	c
2000	95	c
2500	95	c
3150	98	*
4000	97	*
5000	97	*
Sound Transmission Class (STC)	**72**	

Sum of Deficiencies (dB)
23
Max. Deficiency (dB)
8 dB at 200 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Airborne sound transmission loss measurements were conducted in accordance with the requirements of ASTM E90-09, "Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements".**

In the graph:
The solid line is the measured sound transmission loss for this specimen. The dashed line is the STC contour fitted to the measured values according to ASTM E413-10. The dotted line (may be above the displayed range) is 10 dB below the flanking limit established for this facility. For any frequency band where the measured transmission loss is above the dotted line, the reported value is potentially limited by flanking transmission via laboratory surfaces, and the true value may be higher than that measured. Bars at the bottom of the graph show deficiencies where the measured data are less than the reference contour as described in the fitting procedure for the STC, defined in ASTM E413-10. The shaded cells in the table and areas in the graph are outside the STC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. The reported values have been corrected according to the procedure outlined in ASTM E90-09. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level, in which case, the corrected values provide an estimate of the lower limit of airborne sound transmission loss.

ASTM E492 Test Results – Normalized Impact Sound Pressure Levels

Client: Nordic Engineered Wood **Test ID:** IIF-15-011

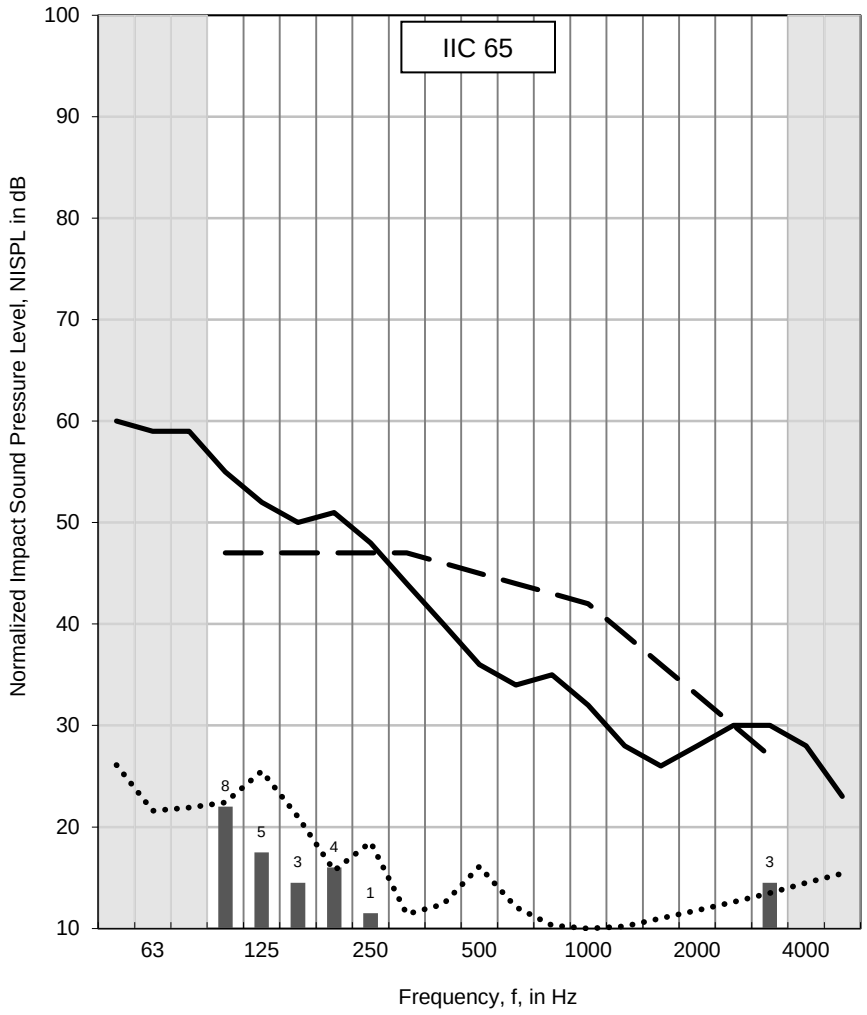
Specimen ID: A1-006070-12F **Date of Test:** March 2, 2015

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Upper	175.3	22.2 to 22.2	33.7 to 34.7
Lower	174.3	19.6 to 19.9	39.5 to 39.8

Area S of test specimen:	17.85 m^2
Mass per unit area:	212 kg/m^2

f (Hz)	NISPL (dB)	
50	60	
63	59	
80	59	
100	55	
125	52	
160	50	
200	51	
250	48	
315	44	
400	40	
500	36	
630	34	
800	35	
1000	32	
1250	28	
1600	26	
2000	28	
2500	30	
3150	30	
4000	28	c
5000	23	*
Impact Insulation Class (IIC)	**65**	

Sum of Positive Differences (dB)
24
Max. Positive Difference (dB)
8 dB at 100 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Measurements of normalized impact sound pressure level (NISPL) were conducted in accordance with the requirements of ASTM E492-09, "Standard Laboratory Measurement of Impact Sound Transmission through Floor-Ceiling Assemblies Using the Tapping Machine".**

In the graph:
The solid line is the measured normalized impact sound pressure level (NISPL) for this specimen. The dashed line is the IIC contour fitted to the measured values according to ASTM E989-06. The dotted line is the background sound level measured in the receiving room during this test (may be below the displayed range). For any frequency where measured NISPL is less than 10 dB above the dotted line, the reported values were adjusted as noted below. Bars at bottom of graph show positive differences; where the measured data are greater than the reference contour as defined in ASTM E989-06. Shaded cells in the table and areas in the graph are outside the IIC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level and the reported values of NISPL provide an estimate of the upper limit of normalized impact sound pressure level, according to the procedure outlined in ASTM E492-09. The reported values of NISPL have been corrected according to the procedure outlined in ASTM E492-09.

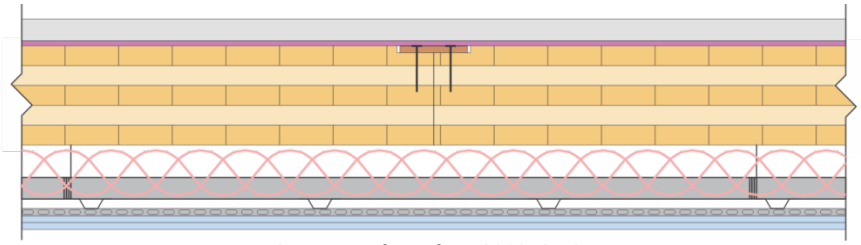
Client	Nordic Engineered Wood 1100 Ave des Canadiens-de-Montreal Montreal QC H3B 2S2
Specimen	38 mm (1-1/2”) precast concrete slab on 9 mm closed cell foam placed on top of a CLT 5 ply (175 mm) with two layers of 13 mm Type C gypsum board installed on a hung ceiling grid with resilient channels.
Specimen ID	A1-006070-13F
Construction Date:	March 3, 2015

Specimen Description

The specimen was composed of two cross-laminated timber (CLT) 5 ply (175 mm thick x 1989 mm wide x 4872 mm long) panels with a butt joint in the middle of the floor. The combined panels filled the entire floor opening of the test frame. The two CLT panels were joined using a 120 mm wide x 12 mm thick plywood strip spanning the full joint (4.9 m). The plywood strip was nailed with common nails 75 mm (3”) long spaced 305 mm (12”) on centre along the joint with beads of PL premium adhesive between the plywood strip and the CLT panels. The CLT floor was resting on the lip of the test frame and was not fastened to the test frame. The air gaps between the edges of the CLT floor and the test frame were filled with glass fiber insulation and covered with cloth tape. Duct putty was installed around the lower perimeter of the test frame and the CLT.

A 38 mm (1-1/2”) precast concrete slab was placed on 9 mm Owens Corning QuietZone® closed cell foam which was placed on the CLT floor.

For the hung ceiling, two layers of 13 mm (5/8”) Type C gypsum board were installed on 13 mm (1/2”) resilient channels. The base layer of gypsum board was attached using 41 mm (1-5/8") long type S screws spaced 305 mm (12”) on centre on every resilient channel. The face layer was staggered from the base later and attached using 50 mm (2") long type S screws spaced 305 mm (12”) on centre on every resilient channel. The exposed gypsum board joints were caulked and taped. The resilient channels were attached perpendicularly to the 22 mm (7/8”) furring channels at a spacing of 406 mm (16”) on centre using screws. The furring channels were attached perpendicularly to 38 mm (1-1/2”) C-channels at a spacing of 406 mm (16”) on centre with wire. The C-channels were attached to the CLT using standard ceiling wire and angles which were screwed into the CLT. The C-channels were spaced 1220 mm (4’) on centre and hung with a space of 52 mm (2”) from the top of the C-channels to the underside the CLT with 92 mm (3-5/8”) Owens Corning EcoTouch Fiberglas® Batts in the cavity. The total hung ceiling depth was 150 mm (6”).



Cross-section of A1-006070-13F

Specimen Properties

Element	Actual thickness (mm)	Mass (kg)	Mass/length, area or volume
38 mm Precast Concrete Slab	38	2023	103.0 kg/m^2
9 mm Owens Corning QuietZone® Closed Cell Foam	9	8	0.4 kg/m^2
175 mm CLT 5-ply	175	1760	91.0 kg/m^2
Standard Ceiling Wire + Angles	52	-	- -
92 mm OC EcoTouch Pink Fiberglas® Batts	92*	29	1.5 kg/m^2
38 mm (1-1/2") C-Channels	38	9	0.5 kg/m
22 mm (7/8”) Furring Channels	22	9	0.2 kg/m
13 mm (1/2”) Resilient Channels	13	13	0.3 kg/m
13 mm (1/2”) CertainTeed Type C Gypsum Board	13	137	7.7 kg/m^2
13 mm (1/2”) CertainTeed Type C Gypsum Board	13	137	7.7 kg/m^2
Total	**373**	**4125**	**213 kg/m^2**

Test Specimen Installation

- The exposed area of the floor specimen used for the calculations of the airborne sound transmission loss was 17.85 m^2 (4.71 m x 3.79 m).
- The total area of the floor assembly resting on top of the lip was 19.32 m^2 (4.88 m x 3.96 m).
- The mass per area of the elements above the lip was calculated using the total area (19.32 m^2) and the mass per area of the elements below the lip was calculated using the exposed area (17.85 m^2).

ASTM E90 Test Results – Airborne Sound Transmission Loss

Client: Nordic Engineered Wood **Test ID:** TLF-15-015

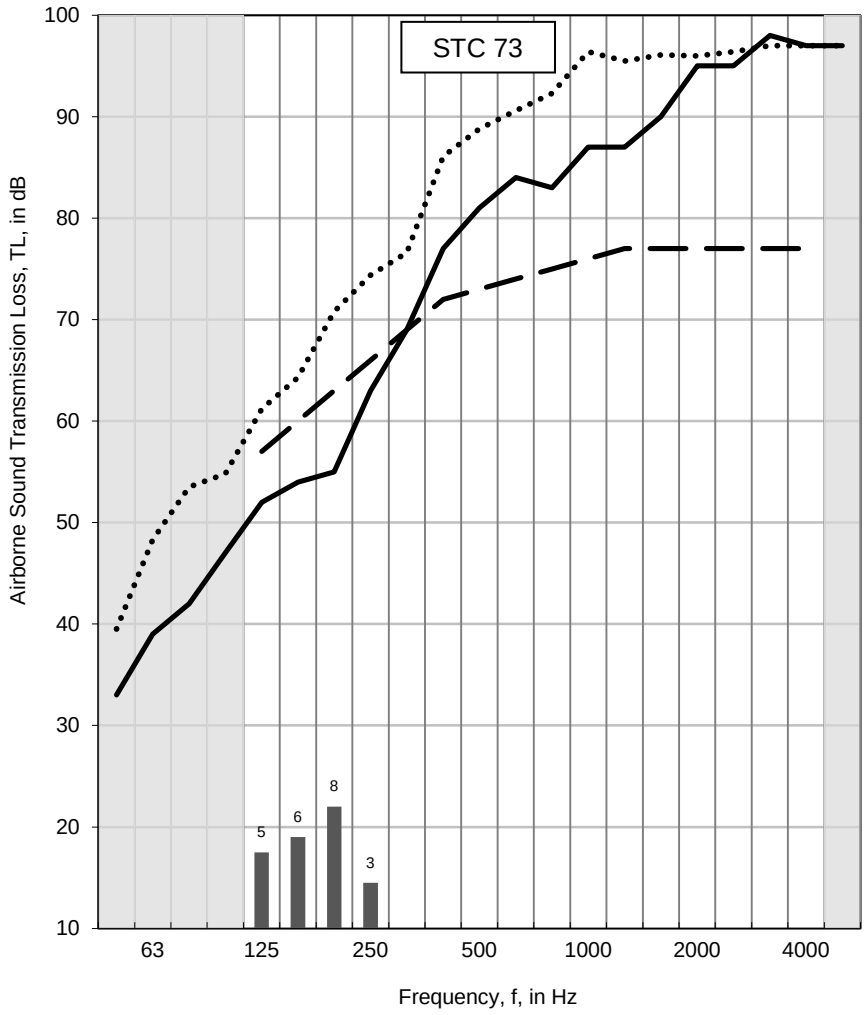
Specimen ID: A1-006070-13F **Date of Test:** March 3 , 2015

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Upper	175.3	22.6 to 22.6	31.2 to 31.7
Lower	174.3	19.9 to 19.9	42.8 to 45.7

Area S of test specimen:	17.85 m^2
Mass per unit area:	213 kg/m^2

f (Hz)	Airborne TL (dB)	
50	33	
63	39	
80	42	
100	47	
125	52	
160	54	
200	55	
250	63	
315	69	
400	77	
500	81	*
630	84	c
800	83	
1000	87	
1250	87	c
1600	90	c
2000	95	c
2500	95	*
3150	98	*
4000	97	*
5000	97	*
Sound Transmission Class (STC)	**73**	

Sum of Deficiencies (dB)
22
Max. Deficiency (dB)
8 dB at 200 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Airborne sound transmission loss measurements were conducted in accordance with the requirements of ASTM E90-09, "Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements".**

In the graph:
The solid line is the measured sound transmission loss for this specimen. The dashed line is the STC contour fitted to the measured values according to ASTM E413-10. The dotted line (may be above the displayed range) is 10 dB below the flanking limit established for this facility. For any frequency band where the measured transmission loss is above the dotted line, the reported value is potentially limited by flanking transmission via laboratory surfaces, and the true value may be higher than that measured. Bars at the bottom of the graph show deficiencies where the measured data are less than the reference contour as described in the fitting procedure for the STC, defined in ASTM E413-10. The shaded cells in the table and areas in the graph are outside the STC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. The reported values have been corrected according to the procedure outlined in ASTM E90-09. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level, in which case, the corrected values provide an estimate of the lower limit of airborne sound transmission loss.

ASTM E492 Test Results – Normalized Impact Sound Pressure Levels

Client: Nordic Engineered Wood **Test ID:** IIF-15-012

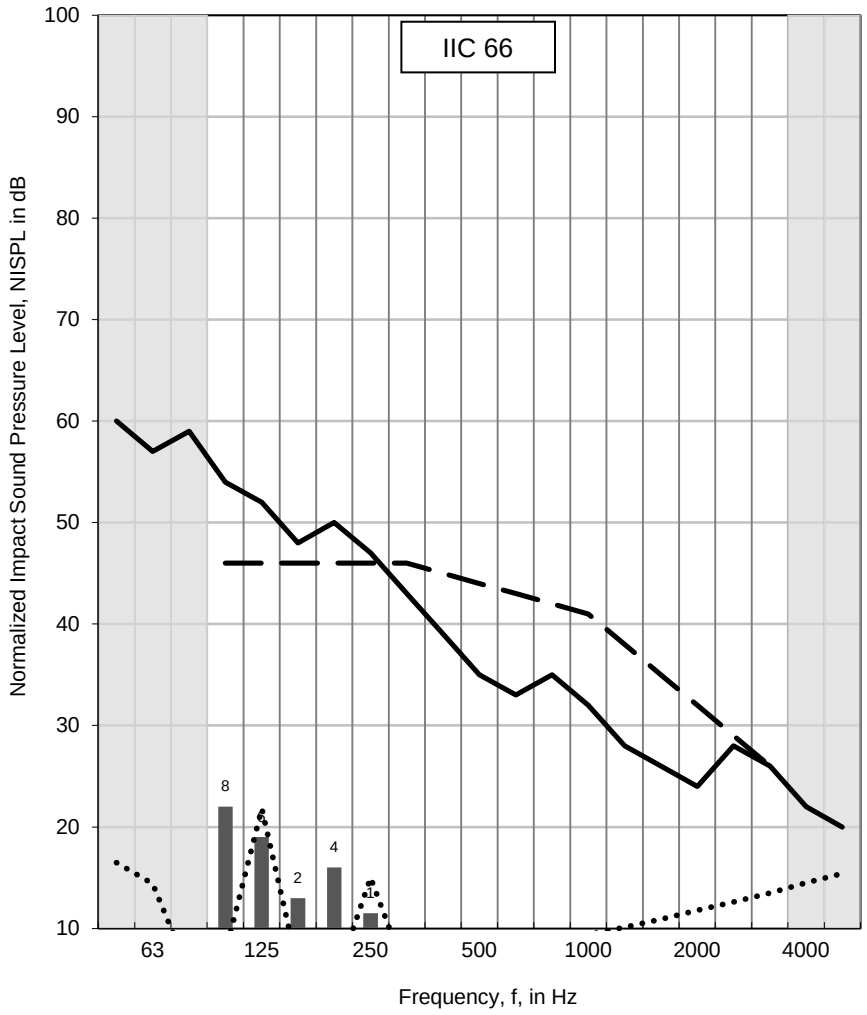
Specimen ID: A1-006070-13F **Date of Test:** March 4, 2015

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Upper	175.3	23.8 to 23.9	29.4 to 29.8
Lower	174.3	18.0 to 18.1	39.2 to 39.6

Area S of test specimen:	17.85 m^2
Mass per unit area:	213 kg/m^2

f (Hz)	NISPL (dB)	
50	60	
63	57	
80	59	
100	54	
125	52	
160	48	
200	50	
250	47	
315	43	
400	39	
500	35	
630	33	
800	35	
1000	32	
1250	28	
1600	26	
2000	24	
2500	28	
3150	26	c
4000	22	*
5000	20	*
Impact Insulation Class (IIC)	**66**	

Sum of Positive Differences (dB)
21
Max. Positive Difference (dB)
6 dB at 100 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Measurements of normalized impact sound pressure level (NISPL) were conducted in accordance with the requirements of ASTM E492-09, "Standard Laboratory Measurement of Impact Sound Transmission through Floor-Ceiling Assemblies Using the Tapping Machine".**

In the graph:
The solid line is the measured normalized impact sound pressure level (NISPL) for this specimen. The dashed line is the IIC contour fitted to the measured values according to ASTM E989-06. The dotted line is the background sound level measured in the receiving room during this test (may be below the displayed range). For any frequency where measured NISPL is less than 10 dB above the dotted line, the reported values were adjusted as noted below. Bars at bottom of graph show positive differences; where the measured data are greater than the reference contour as defined in ASTM E989-06. Shaded cells in the table and areas in the graph are outside the IIC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level and the reported values of NISPL provide an estimate of the upper limit of normalized impact sound pressure level, according to the procedure outlined in ASTM E492-09. The reported values of NISPL have been corrected according to the procedure outlined in ASTM E492-09.

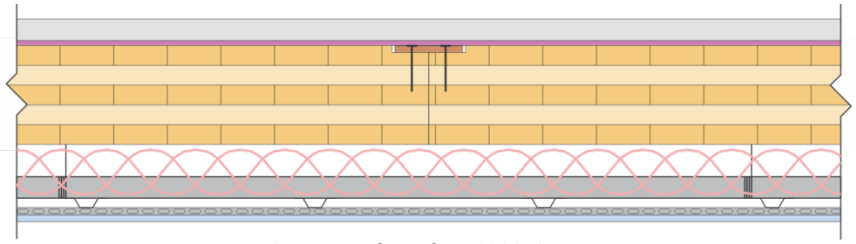
Client	Nordic Engineered Wood 1100 Ave des Canadiens-de-Montreal Montreal QC H3B 2S2
Specimen	38 mm (1-1/2”) precast concrete slab on 9 mm closed cell foam placed on top of a CLT 5 ply (175 mm) with one layer of 13 mm Type C gypsum board installed on a hung ceiling grid with resilient channels
Specimen ID	A1-006070-14F
Construction Date:	March 5, 2015

Specimen Description

The specimen was composed of two cross-laminated timber (CLT) 5 ply (175 mm thick x 1989 mm wide x 4872 mm long) panels with a butt joint in the middle of the floor. The combined panels filled the entire floor opening of the test frame. The two CLT panels were joined using a 120 mm wide x 12 mm thick plywood strip spanning the full joint (4.9 m). The plywood strip was nailed with common nails 75 mm (3”) long spaced 305 mm (12”) on centre along the joint with beads of PL premium adhesive between the plywood strip and the CLT panels. The CLT floor was resting on the lip of the test frame and was not fastened to the test frame. The air gaps between the edges of the CLT floor and the test frame were filled with glass fiber insulation and covered with cloth tape. Duct putty was installed around the lower perimeter of the test frame and the CLT.

A 38 mm (1-1/2”) precast concrete slab was placed on 9 mm Owens Corning QuietZone® closed cell foam which was placed on the CLT floor.

For the hung ceiling, one layers of 13 mm (5/8”) Type C gypsum board was installed on 13 mm (1/2”) resilient channels. The layer of gypsum board was attached using 41 mm (1-5/8") long type S screws spaced 305 mm (12”) on centre on every resilient channel. The exposed gypsum board joints were caulked and taped. The resilient channels were attached perpendicularly to the 22 mm (7/8”) furring channels at a spacing of 406 mm (16”) on centre using screws. The furring channels were attached perpendicularly to 38 mm (1-1/2”) C-channels at a spacing of 406 mm (16”) on centre with wire. The C-channels were attached to the CLT using standard ceiling wire and angles which were screwed into the CLT. The C-channels were spaced 1220 mm (4’) on centre and hung with a space of 52 mm (2”) from the top of the C-channels to the underside the CLT with 92 mm (3-5/8”) Owens Corning EcoTouch Fiberglas® Batts in the cavity. The total hung ceiling depth was 140 mm (5-1/2”).



Cross-section of A1-006070-14F

Specimen Properties

Element	Actual thickness (mm)	Mass (kg)	Mass/length, area or volume
38 mm Precast Concrete Slab	38	2023	103.0 kg/m^2
9 mm Owens Corning QuietZone® Closed Cell Foam	9	8	0.4 kg/m^2
175 mm CLT 5-ply	175	1760	91.0 kg/m^2
Standard Ceiling Wire + Angles	52	-	- -
92 mm OC EcoTouch Pink Fiberglas® Batts	92*	29	1.5 kg/m^2
38 mm (1-1/2") C-Channels	38	9	0.5 kg/m
22 mm (7/8”) Furring Channels	22	9	0.2 kg/m
13 mm (1/2”) Resilient Channels	13	13	0.3 kg/m
13 mm (1/2”) CertainTeed Type C Gypsum Board	13	137	7.7 kg/m^2
Total	**360**	**3988**	**206 kg/m^2**

Test Specimen Installation

- The exposed area of the floor specimen used for the calculations of the airborne sound transmission loss was 17.85 m^2 (4.71 m x 3.79 m).
- The total area of the floor assembly resting on top of the lip was 19.32 m^2 (4.88 m x 3.96 m).
- The mass per area of the elements above the lip was calculated using the total area (19.32 m^2) and the mass per area of the elements below the lip was calculated using the exposed area (17.85 m^2).

ASTM E90 Test Results – Airborne Sound Transmission Loss

Client: Nordic Engineered Wood **Test ID:** TLF-15-016

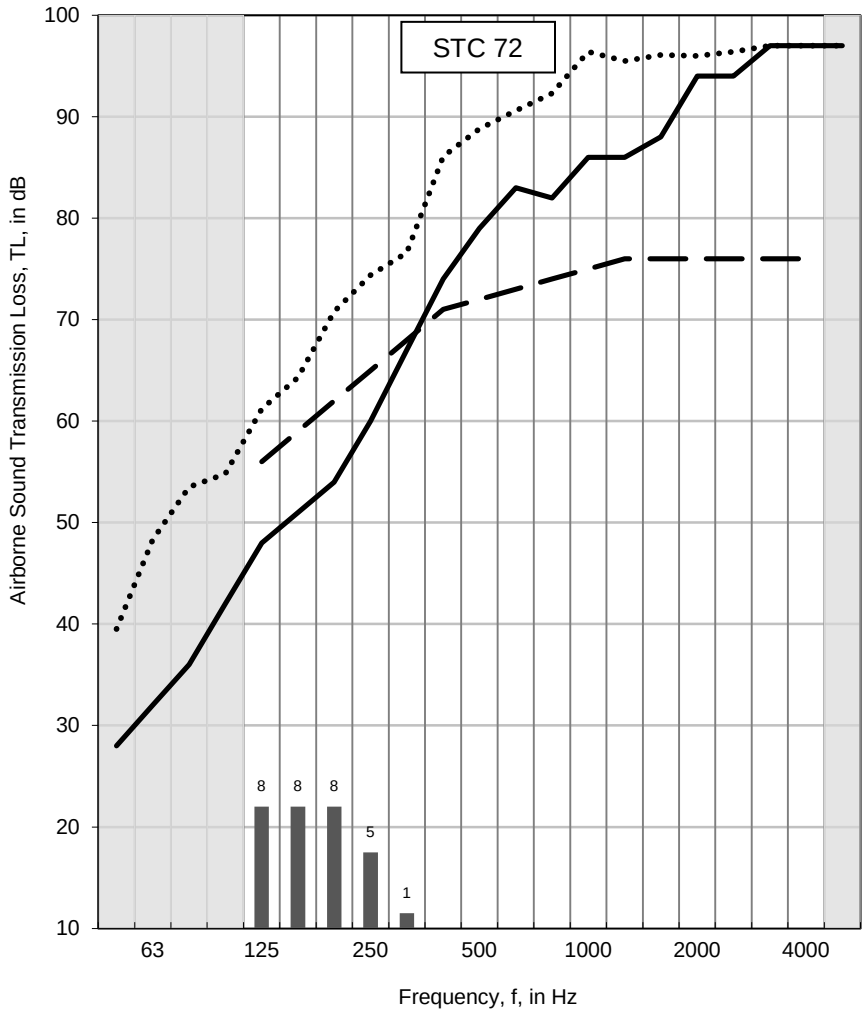
Specimen ID: A1-006070-14F **Date of Test:** March 6, 2015

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Upper	175.3	26.1 to 26.1	33.6 to 34.3
Lower	174.6	17.4 to 17.4	43.5 to 43.9

Area S of test specimen:	17.85 m^2
Mass per unit area:	206 kg/m^2

f (Hz)	Airborne TL (dB)	
50	28	
63	32	
80	36	
100	42	
125	48	
160	51	
200	54	
250	60	
315	67	
400	74	*
500	79	*
630	83	c
800	82	c
1000	86	c
1250	86	c
1600	88	c
2000	94	*
2500	94	*
3150	97	*
4000	97	*
5000	97	*
Sound Transmission Class (STC)	**72**	

Sum of Deficiencies (dB)
30
Max. Deficiency (dB)
8 dB at 125, 160 and 200 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Airborne sound transmission loss measurements were conducted in accordance with the requirements of ASTM E90-09, "Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements".**

In the graph:
The solid line is the measured sound transmission loss for this specimen. The dashed line is the STC contour fitted to the measured values according to ASTM E413-10. The dotted line (may be above the displayed range) is 10 dB below the flanking limit established for this facility. For any frequency band where the measured transmission loss is above the dotted line, the reported value is potentially limited by flanking transmission via laboratory surfaces, and the true value may be higher than that measured. Bars at the bottom of the graph show deficiencies where the measured data are less than the reference contour as described in the fitting procedure for the STC, defined in ASTM E413-10. The shaded cells in the table and areas in the graph are outside the STC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. The reported values have been corrected according to the procedure outlined in ASTM E90-09. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level, in which case, the corrected values provide an estimate of the lower limit of airborne sound transmission loss.

ASTM E492 Test Results – Normalized Impact Sound Pressure Levels

Client: Nordic Engineered Wood **Test ID:** IIF-15-013

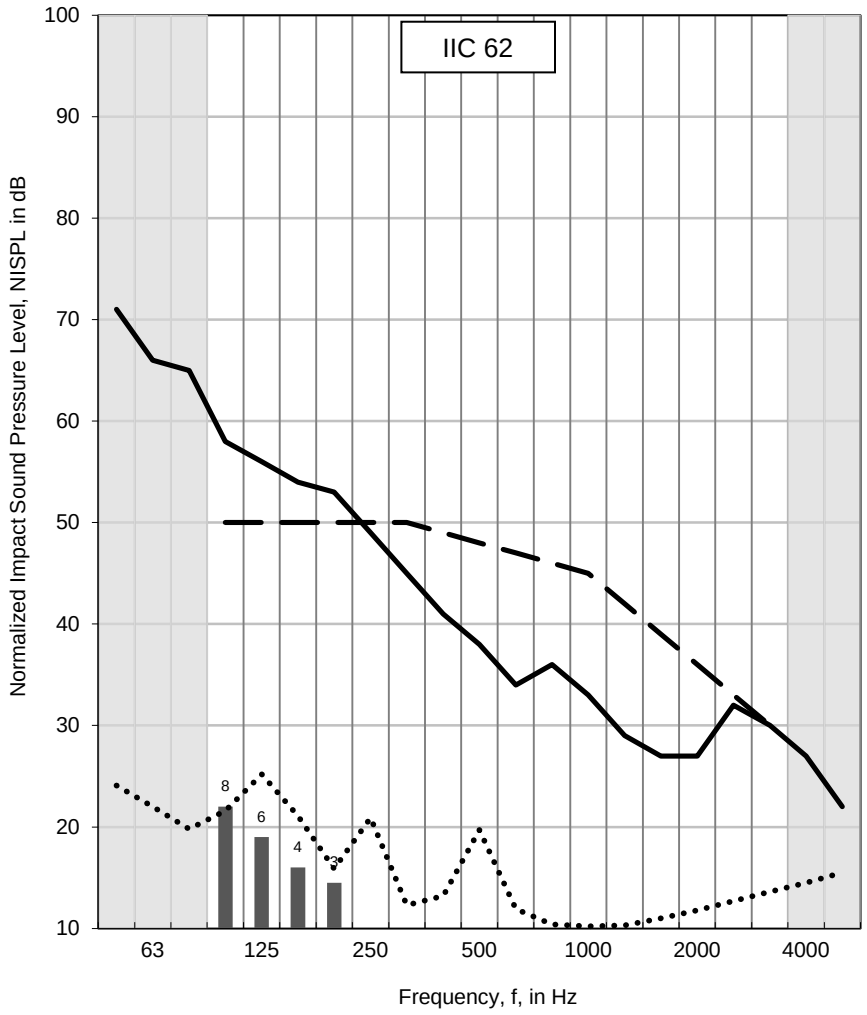
Specimen ID: A1-006070-14F **Date of Test:** March 5, 2015

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Upper	175.3	25.2 to 25.2	32.5 to 32.7
Lower	174.6	19.9 to 19.9	39.6 to 40.3

Area S of test specimen:	17.85 m^2
Mass per unit area:	206 kg/m^2

f (Hz)	NISPL (dB)	
50	71	
63	66	
80	65	
100	58	
125	56	
160	54	
200	53	
250	49	
315	45	
400	41	
500	38	
630	34	
800	36	
1000	33	
1250	29	
1600	27	
2000	27	
2500	32	
3150	30	
4000	27	c
5000	22	*
Impact Insulation Class (IIC)	**62**	

Sum of Positive Differences (dB)
21
Max. Positive Difference (dB)
8 dB at 100 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Measurements of normalized impact sound pressure level (NISPL) were conducted in accordance with the requirements of ASTM E492-09, "Standard Laboratory Measurement of Impact Sound Transmission through Floor-Ceiling Assemblies Using the Tapping Machine".**

In the graph:
The solid line is the measured normalized impact sound pressure level (NISPL) for this specimen. The dashed line is the IIC contour fitted to the measured values according to ASTM E989-06. The dotted line is the background sound level measured in the receiving room during this test (may be below the displayed range). For any frequency where measured NISPL is less than 10 dB above the dotted line, the reported values were adjusted as noted below. Bars at bottom of graph show positive differences; where the measured data are greater than the reference contour as defined in ASTM E989-06. Shaded cells in the table and areas in the graph are outside the IIC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level and the reported values of NISPL provide an estimate of the upper limit of normalized impact sound pressure level, according to the procedure outlined in ASTM E492-09. The reported values of NISPL have been corrected according to the procedure outlined in ASTM E492-09.

Client Nordic Engineered Wood
1100 Ave des Canadiens-de-Montreal
Montreal QC H3B 2S2

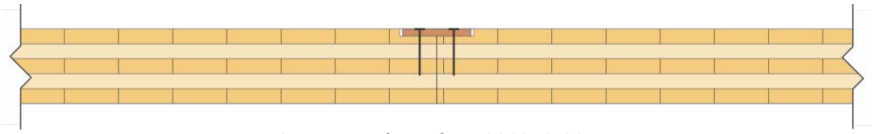
Specimen Bare CLT 5 ply (131 mm)

Specimen ID A1-006070-20F

Construction Date: March 6, 2015 to March 9, 2015

Specimen Description

The specimen was composed of two cross-laminated timber (CLT) 5 ply (131 mm thick x 1989 mm wide x 4872 mm long) panels with a butt joint in the middle of the floor. The combined panels filled the entire floor opening of the test frame. The two CLT panels were joined using a 120 mm wide x 12 mm thick plywood strip spanning the full joint (4.9 m). The plywood strip was nailed with common nails 75 mm (3") long spaced 305 mm (12") on centre along the joint with beads of PL premium adhesive between the plywood strip and the CLT panels. The CLT floor was resting on the lip of the test frame and was not fastened to the test frame. The air gaps between the edges of the CLT floor and the test frame were filled with glass fiber insulation and covered with cloth tape. Duct putty was installed around the lower perimeter of the test frame and the CLT.



Cross-section of A1-006070-20F

Specimen Properties

Element	Actual thickness (mm)	Mass (kg)	Mass/length, area or volume
131 mm CLT 5-ply	131	1338	67.0 kg/m^2
Total	**131**	**1338**	**67 kg/m^2**

Test Specimen Installation

- The exposed area of the floor specimen used for the calculations of the airborne sound transmission loss was 17.85 m^2 (4.71 m x 3.79 m).
- The total area of the floor assembly resting on top of the lip was 19.32 m^2 (4.88 m x 3.96 m).
- The mass per area of the elements above the lip was calculated using the total area (19.32 m^2).

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ASTM E90 Test Results – Airborne Sound Transmission Loss

Client: Nordic Engineered Wood **Test ID:** TLF-15-017

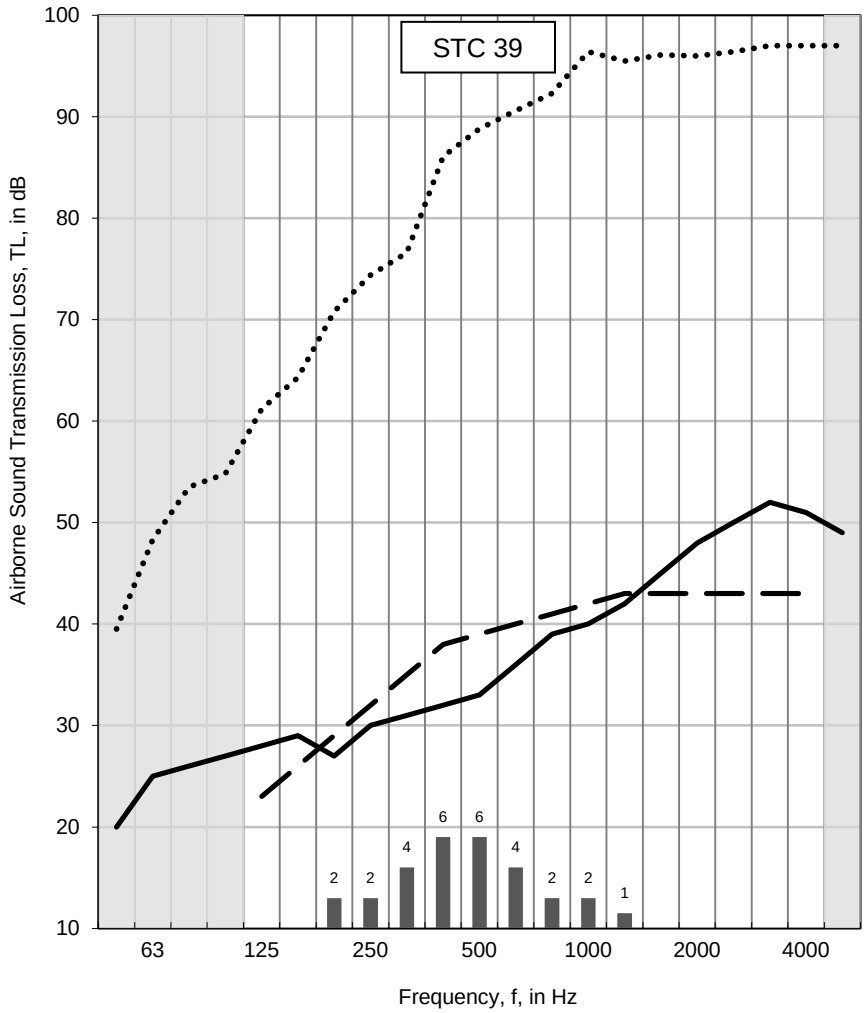
Specimen ID: A1-006070-20F **Date of Test:** March 9, 2015

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Upper	176.7	25.0 to 25.2	32.3 to 32.7
Lower	177.2	19.5 to 19.6	41.3 to 41.4

Area S of test specimen:	17.85 m^2
Mass per unit area:	67 kg/m^2

f (Hz)	Airborne TL (dB)
50	20
63	25
80	26
100	27
125	28
160	29
200	27
250	30
315	31
400	32
500	33
630	36
800	39
1000	40
1250	42
1600	45
2000	48
2500	50
3150	52
4000	51
5000	49
Sound Transmission Class (STC)	**39**

Sum of Deficiencies (dB)
29
Max. Deficiency (dB)
6 dB at 400 and 500 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Airborne sound transmission loss measurements were conducted in accordance with the requirements of ASTM E90-09, "Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements".**

In the graph:
The solid line is the measured sound transmission loss for this specimen. The dashed line is the STC contour fitted to the measured values according to ASTM E413-10. The dotted line (may be above the displayed range) is 10 dB below the flanking limit established for this facility. For any frequency band where the measured transmission loss is above the dotted line, the reported value is potentially limited by flanking transmission via laboratory surfaces, and the true value may be higher than that measured. Bars at the bottom of the graph show deficiencies where the measured data are less than the reference contour as described in the fitting procedure for the STC, defined in ASTM E413-10. The shaded cells in the table and areas in the graph are outside the STC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. The reported values have been corrected according to the procedure outlined in ASTM E90-09. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level, in which case, the corrected values provide an estimate of the lower limit of airborne sound transmission loss.

ASTM E492 Test Results – Normalized Impact Sound Pressure Levels

Client: Nordic Engineered Wood **Test ID:** IIF-15-014

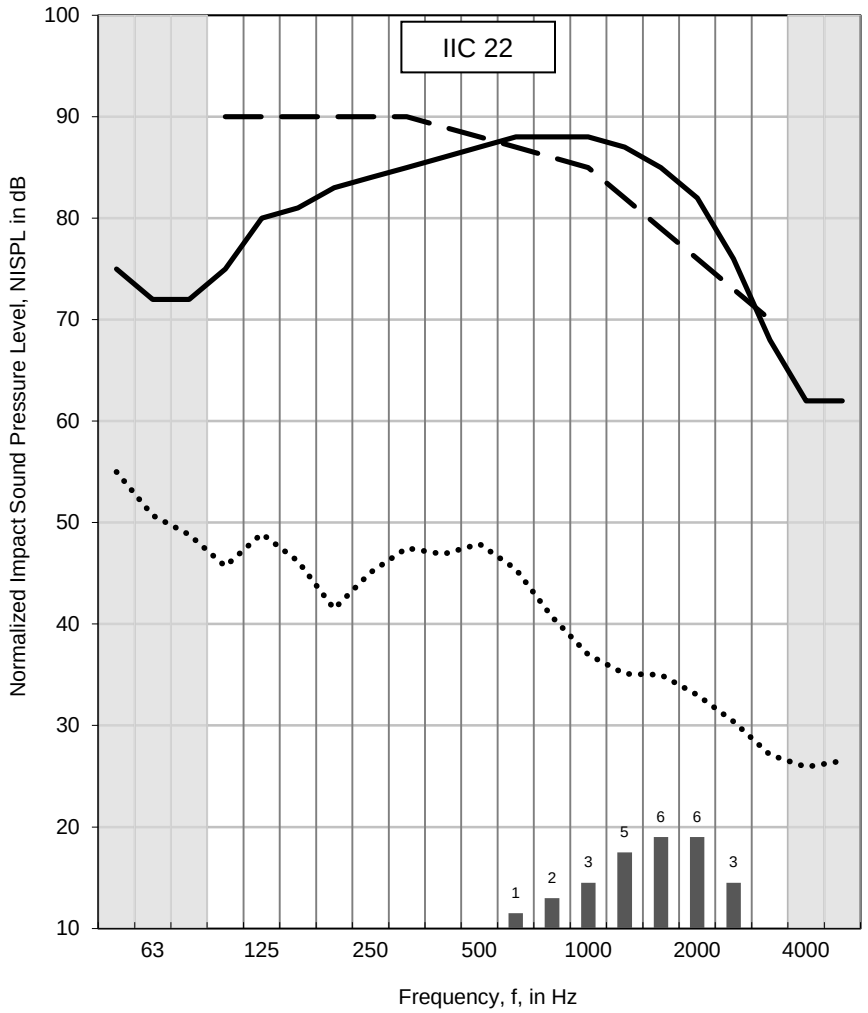
Specimen ID: A1-006070-20F **Date of Test:** March 9, 2015

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Upper	176.7	25.1 to 25.1	32.7 to 32.7
Lower	177.2	19.5 to 19.6	41.3 to 41.4

Area S of test specimen:	17.85 m^2
Mass per unit area:	67 kg/m^2

f (Hz)	NISPL (dB)	
50	75	c
63	72	
80	72	
100	75	
125	80	
160	81	
200	83	
250	84	
315	85	
400	86	
500	87	
630	88	
800	88	
1000	88	
1250	87	
1600	85	
2000	82	
2500	76	
3150	68	
4000	62	
5000	62	
Impact Insulation Class (IIC)	**22**	

Sum of Positive Differences (dB)
26
Max. Positive Difference (dB)
6 dB at 1600 and 2000 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Measurements of normalized impact sound pressure level (NISPL) were conducted in accordance with the requirements of ASTM E492-09, "Standard Laboratory Measurement of Impact Sound Transmission through Floor-Ceiling Assemblies Using the Tapping Machine".**

In the graph:
The solid line is the measured normalized impact sound pressure level (NISPL) for this specimen. The dashed line is the IIC contour fitted to the measured values according to ASTM E989-06. The dotted line is the background sound level measured in the receiving room during this test (may be below the displayed range). For any frequency where measured NISPL is less than 10 dB above the dotted line, the reported values were adjusted as noted below. Bars at bottom of graph show positive differences; where the measured data are greater than the reference contour as defined in ASTM E989-06. Shaded cells in the table and areas in the graph are outside the IIC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level and the reported values of NISPL provide an estimate of the upper limit of normalized impact sound pressure level, according to the procedure outlined in ASTM E492-09. The reported values of NISPL have been corrected according to the procedure outlined in ASTM E492-09.

Client Nordic Engineered Wood
1100 Ave des Canadiens-de-Montreal
Montreal QC H3B 2S2

Specimen 38 mm (1-1/2") precast concrete slab on 13 mm (1/2") rubber membrane placed on top of a CLT 5 ply (131 mm).

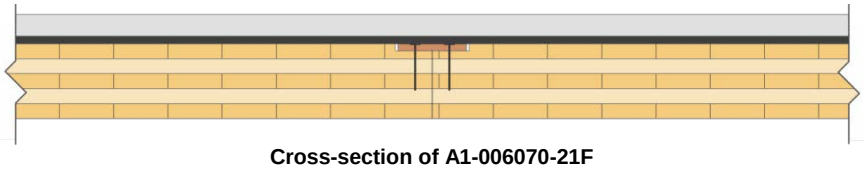
Specimen ID A1-006070-21F

Construction Date: March 13, 2015

Specimen Description

The specimen was composed of two cross-laminated timber (CLT) 5 ply (131 mm thick x 1989 mm wide x 4872 mm long) panels with a butt joint in the middle of the floor. The combined panels filled the entire floor opening of the test frame. The two CLT panels were joined using a 120 mm wide x 12 mm thick plywood strip spanning the full joint (4.9 m). The plywood strip was nailed with common nails 75 mm (3") long spaced 305 mm (12") on centre along the joint with beads of PL premium adhesive between the plywood strip and the CLT panels. The CLT floor was resting on the lip of the test frame and was not fastened to the test frame. The air gaps between the edges of the CLT floor and the test frame were filled with glass fiber insulation and covered with cloth tape. Duct putty was installed around the lower perimeter of the test frame and the CLT.

A 38 mm (1-1/2") precast concrete slab was placed on a 13 mm (1/2") INSONOMAT rubber membrane which was placed on the CLT floor.



Cross-section of A1-006070-21F

Specimen Properties

Element	Actual thickness (mm)	Mass (kg)	Mass/length, area or volume
38 mm Precast Concrete Slab	38	2023	103.0 kg/m^2
13 mm INSONOMAT Rubber Membrane	13	90	4.5 kg/m^2
131 mm CLT 5-ply	131	1338	67.0 kg/m^2
Total	**182**	**3451**	**175 kg/m^2**

Test Specimen Installation

- The exposed area of the floor specimen used for the calculations of the airborne sound transmission loss was 17.85 m^2 (4.71 m x 3.79 m).
- The total area of the floor assembly resting on top of the lip was 19.32 m^2 (4.88 m x 3.96 m).
- The mass per area of the elements above the lip was calculated using the total area (19.32 m^2).

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ASTM E90 Test Results – Airborne Sound Transmission Loss

Client: Nordic Engineered Wood **Test ID:** TLF-15-018

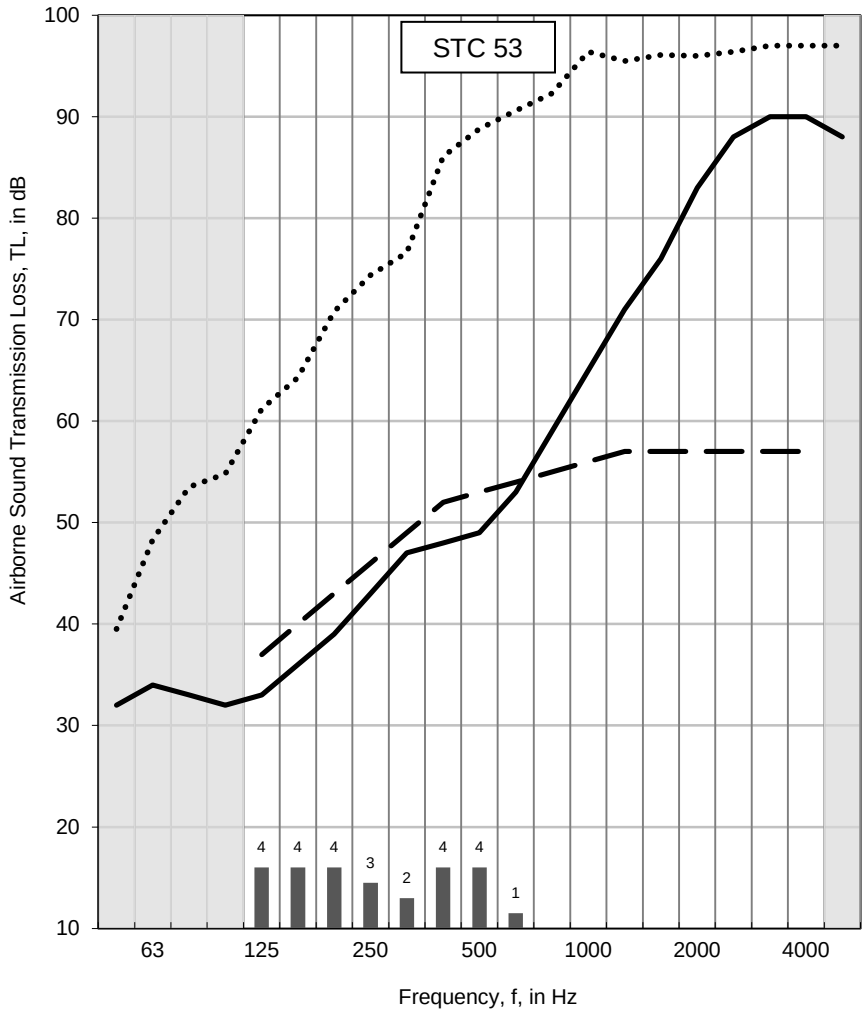
Specimen ID: A1-006070-21F **Date of Test:** March 13, 2015

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Upper	175.8	23.8 to 23.8	32.6 to 33.2
Lower	177.1	18.9 to 19.2	39.9 to 40.3

Area S of test specimen:	17.85 m^2
Mass per unit area:	175 kg/m^2

f (Hz)	Airborne TL (dB)
50	32
63	34
80	33
100	32
125	33
160	36
200	39
250	43
315	47
400	48
500	49
630	53
800	59
1000	65
1250	71
1600	76
2000	83
2500	88
3150	90
4000	90
5000	88
Sound Transmission Class (STC)	**53**

Sum of Deficiencies (dB)
26
Max. Deficiency (dB)
4dB at 125, 160, 200, 400 and 500Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Airborne sound transmission loss measurements were conducted in accordance with the requirements of ASTM E90-09, "Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements".**

In the graph:
The solid line is the measured sound transmission loss for this specimen. The dashed line is the STC contour fitted to the measured values according to ASTM E413-10. The dotted line (may be above the displayed range) is 10 dB below the flanking limit established for this facility. For any frequency band where the measured transmission loss is above the dotted line, the reported value is potentially limited by flanking transmission via laboratory surfaces, and the true value may be higher than that measured. Bars at the bottom of the graph show deficiencies where the measured data are less than the reference contour as described in the fitting procedure for the STC, defined in ASTM E413-10. The shaded cells in the table and areas in the graph are outside the STC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. The reported values have been corrected according to the procedure outlined in ASTM E90-09. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level, in which case, the corrected values provide an estimate of the lower limit of airborne sound transmission loss.

ASTM E492 Test Results – Normalized Impact Sound Pressure Levels

Client: Nordic Engineered Wood **Test ID:** IIF-15-015

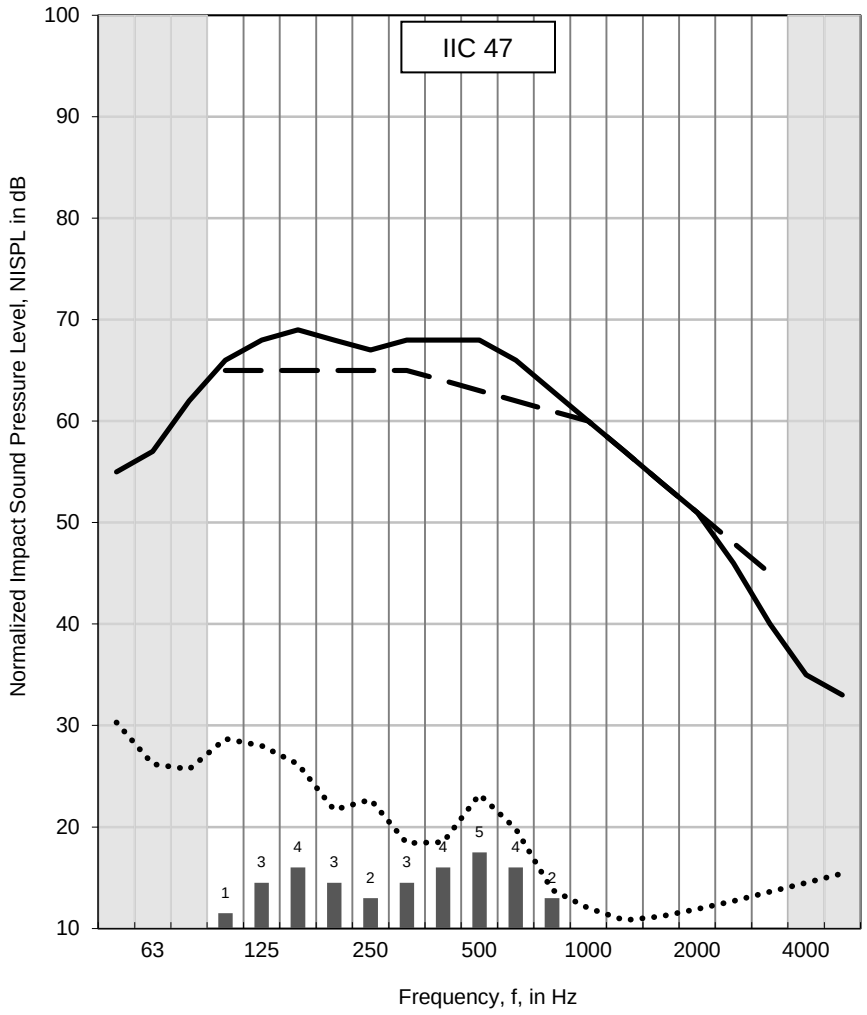
Specimen ID: A1-006070-21F **Date of Test:** March 16, 2015

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Upper	175.8	25.7 to 26.0	29.8 to 32.3
Lower	177.1	18.0 to 18.0	42.1 to 42.1

Area S of test specimen:	17.85 m^2
Mass per unit area:	175 kg/m^2

f (Hz)	NISPL (dB)
50	55
63	57
80	62
100	66
125	68
160	69
200	68
250	67
315	68
400	68
500	68
630	66
800	63
1000	60
1250	57
1600	54
2000	51
2500	46
3150	40
4000	35
5000	33
Impact Insulation Class (IIC)	**47**

Sum of Positive Differences (dB)
31
Max. Positive Difference (dB)
5 dB at 500 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Measurements of normalized impact sound pressure level (NISPL) were conducted in accordance with the requirements of ASTM E492-09, "Standard Laboratory Measurement of Impact Sound Transmission through Floor-Ceiling Assemblies Using the Tapping Machine".**

In the graph:
The solid line is the measured normalized impact sound pressure level (NISPL) for this specimen. The dashed line is the IIC contour fitted to the measured values according to ASTM E989-06. The dotted line is the background sound level measured in the receiving room during this test (may be below the displayed range). For any frequency where measured NISPL is less than 10 dB above the dotted line, the reported values were adjusted as noted below. Bars at bottom of graph show positive differences; where the measured data are greater than the reference contour as defined in ASTM E989-06. Shaded cells in the table and areas in the graph are outside the IIC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level and the reported values of NISPL provide an estimate of the upper limit of normalized impact sound pressure level, according to the procedure outlined in ASTM E492-09. The reported values of NISPL have been corrected according to the procedure outlined in ASTM E492-09.

Client Nordic Engineered Wood
1100 Ave des Canadiens-de-Montreal
Montreal QC H3B 2S2

Specimen 38 mm (1-1/2") precast concrete slab on 9 mm closed cell foam placed on top of a CLT 5 ply (131 mm).

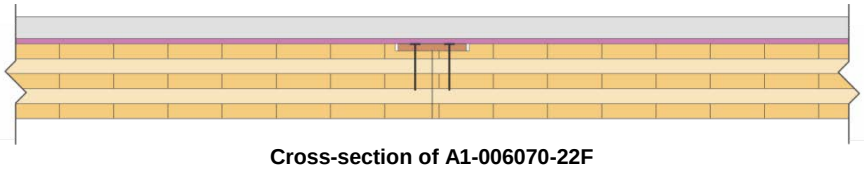
Specimen ID A1-006070-22F

Construction Date: March 17, 2015

Specimen Description

The specimen was composed of two cross-laminated timber (CLT) 5 ply (131 mm thick x 1989 mm wide x 4872 mm long) panels with a butt joint in the middle of the floor. The combined panels filled the entire floor opening of the test frame. The two CLT panels were joined using a 120 mm wide x 12 mm thick plywood strip spanning the full joint (4.9 m). The plywood strip was nailed with common nails 75 mm (3") long spaced 305 mm (12") on centre along the joint with beads of PL premium adhesive between the plywood strip and the CLT panels. The CLT floor was resting on the lip of the test frame and was not fastened to the test frame. The air gaps between the edges of the CLT floor and the test frame were filled with glass fiber insulation and covered with cloth tape. Duct putty was installed around the lower perimeter of the test frame and the CLT.

A 38 mm (1-1/2") precast concrete slab was placed on 9 mm Owens Corning QuietZone® closed cell foam which was placed on the CLT floor.



Cross-section of A1-006070-22F

Specimen Properties

Element	Actual thickness (mm)	Mass (kg)	Mass/length, area or volume
38 mm Precast Concrete Slab	38	2023	103.0 kg/m^2
9 mm Owens Corning QuietZone® Closed Cell Foam	9	7.5	0.4 kg/m^2
131 mm CLT 5-ply	131	1338	67.0 kg/m^2
Total	**178**	**3369**	**170 kg/m^2**

Test Specimen Installation

- The exposed area of the floor specimen used for the calculations of the airborne sound transmission loss was 17.85 m^2 (4.71 m x 3.79 m).
- The total area of the floor assembly resting on top of the lip was 19.32 m^2 (4.88 m x 3.96 m).
- The mass per area of the elements above the lip was calculated using the total area (19.32 m^2).

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ASTM E90 Test Results – Airborne Sound Transmission Loss

Client: Nordic Engineered Wood **Test ID:** TLF-15-019

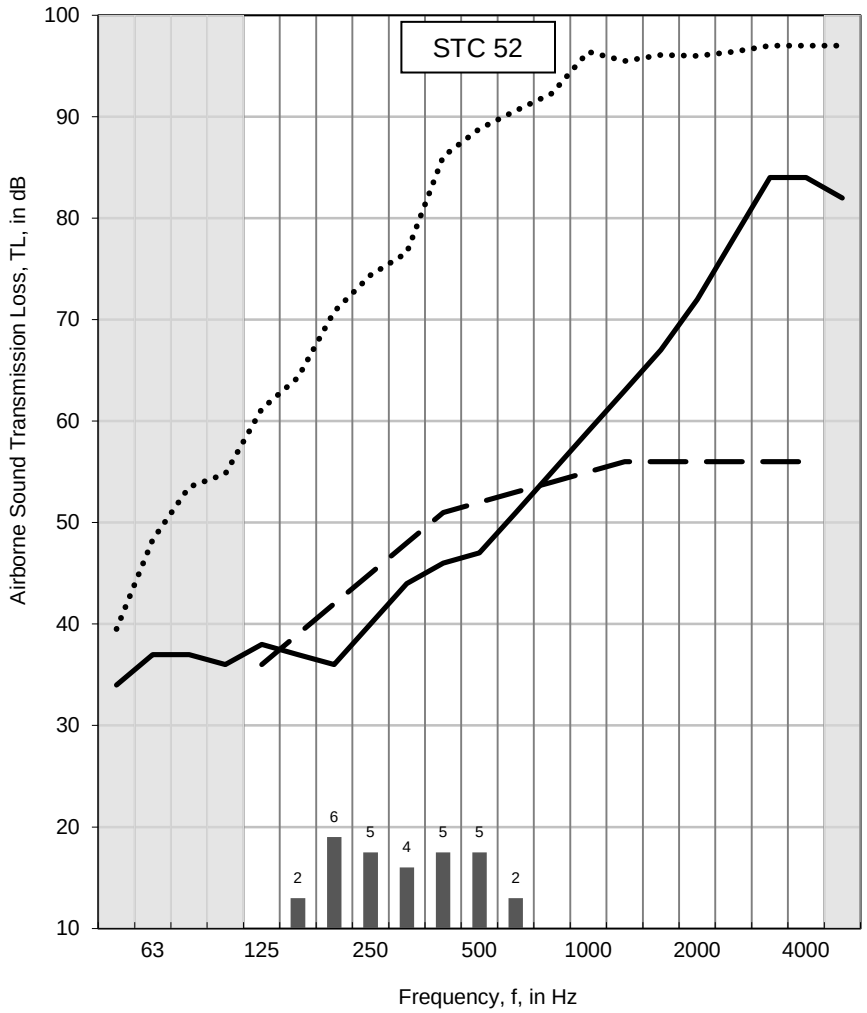
Specimen ID: A1-006070-22F **Date of Test:** March 19, 2015

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Upper	175.9	27.0 to 27.4	36.9 to 37.8
Lower	177.1	17.9 to 17.9	42.4 to 42.6

Area S of test specimen:	17.85 m^2
Mass per unit area:	170 kg/m^2

f (Hz)	Airborne TL (dB)
50	34
63	37
80	37
100	36
125	38
160	37
200	36
250	40
315	44
400	46
500	47
630	51
800	55
1000	59
1250	63
1600	67
2000	72
2500	78
3150	84
4000	84
5000	82
Sound Transmission Class (STC)	**52**

Sum of Deficiencies (dB)
29
Max. Deficiency (dB)
6 dB at 200 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Airborne sound transmission loss measurements were conducted in accordance with the requirements of ASTM E90-09, "Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements" with the exception that the temperature in the upper room was higher than 27ºC.**

In the graph:
The solid line is the measured sound transmission loss for this specimen. The dashed line is the STC contour fitted to the measured values according to ASTM E413-10. The dotted line (may be above the displayed range) is 10 dB below the flanking limit established for this facility. For any frequency band where the measured transmission loss is above the dotted line, the reported value is potentially limited by flanking transmission via laboratory surfaces, and the true value may be higher than that measured. Bars at the bottom of the graph show deficiencies where the measured data are less than the reference contour as described in the fitting procedure for the STC, defined in ASTM E413-10. The shaded cells in the table and areas in the graph are outside the STC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. The reported values have been corrected according to the procedure outlined in ASTM E90-09. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level, in which case, the corrected values provide an estimate of the lower limit of airborne sound transmission loss.

ASTM E492 Test Results – Normalized Impact Sound Pressure Levels

Client: Nordic Engineered Wood **Test ID:** IIF-15-017

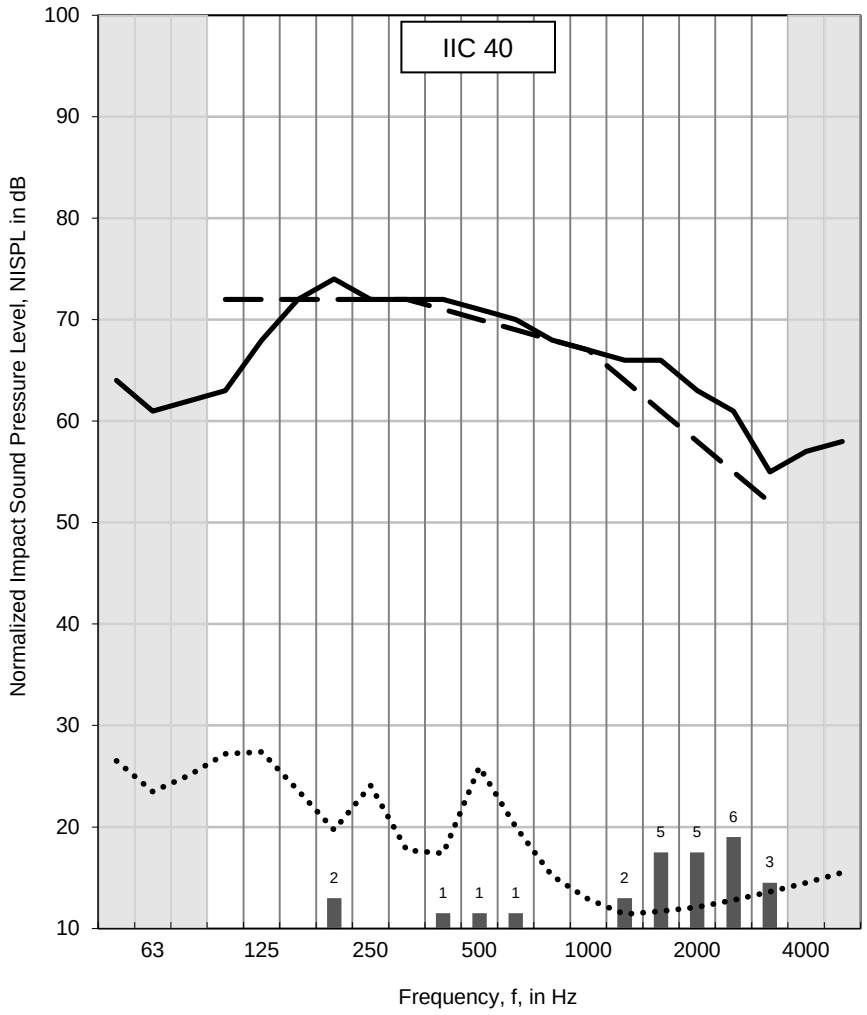
Specimen ID: A1-006070-22F **Date of Test:** March 19, 2015

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Upper	175.9	26.9 to 26.9	32.2 to 34.2
Lower	177.1	17.8 to 17.8	42.2 to 42.6

Area S of test specimen:	17.85 m^2
Mass per unit area:	170 kg/m^2

f (Hz)	NISPL (dB)
50	64
63	61
80	62
100	63
125	68
160	72
200	74
250	72
315	72
400	72
500	71
630	70
800	68
1000	67
1250	66
1600	66
2000	63
2500	61
3150	55
4000	57
5000	58
Impact Insulation Class (IIC)	**40**

Sum of Positive Differences (dB)
26
Max. Positive Difference (dB)
6 dB at 2500 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Measurements of normalized impact sound pressure level (NISPL) were conducted in accordance with the requirements of ASTM E492-09, "Standard Laboratory Measurement of Impact Sound Transmission through Floor-Ceiling Assemblies Using the Tapping Machine".**

In the graph:
The solid line is the measured normalized impact sound pressure level (NISPL) for this specimen. The dashed line is the IIC contour fitted to the measured values according to ASTM E989-06. The dotted line is the background sound level measured in the receiving room during this test (may be below the displayed range). For any frequency where measured NISPL is less than 10 dB above the dotted line, the reported values were adjusted as noted below. Bars at bottom of graph show positive differences; where the measured data are greater than the reference contour as defined in ASTM E989-06. Shaded cells in the table and areas in the graph are outside the IIC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level and the reported values of NISPL provide an estimate of the upper limit of normalized impact sound pressure level, according to the procedure outlined in ASTM E492-09. The reported values of NISPL have been corrected according to the procedure outlined in ASTM E492-09.

Client Nordic Engineered Wood
1100 Ave des Canadiens-de-Montreal
Montreal QC H3B 2S2

Specimen 38 mm (1-1/2") precast concrete slab on 10 mm tar board placed on top of a CLT 5 ply (131 mm).

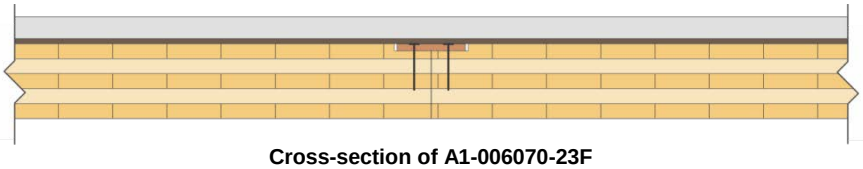
Specimen ID A1-006070-23F

Construction Date: March 25, 2015

Specimen Description

The specimen was composed of two cross-laminated timber (CLT) 5 ply (131 mm thick x 1989 mm wide x 4872 mm long) panels with a butt joint in the middle of the floor. The combined panels filled the entire floor opening of the test frame. The two CLT panels were joined using a 120 mm wide x 12 mm thick plywood strip spanning the full joint (4.9 m). The plywood strip was nailed with common nails 75 mm (3") long spaced 305 mm (12") on centre along the joint with beads of PL premium adhesive between the plywood strip and the CLT panels. The CLT floor was resting on the lip of the test frame and was not fastened to the test frame. The air gaps between the edges of the CLT floor and the test frame were filled with glass fiber insulation and covered with cloth tape. Duct putty was installed around the lower perimeter of the test frame and the CLT.

A 38 mm (1-1/2") precast concrete slab was placed on 10 mm tar boards which were placed on the CLT floor.



Cross-section of A1-006070-23F

Specimen Properties

Element	Actual thickness (mm)	Mass (kg)	Mass/length, area or volume
38 mm Precast Concrete Slab	38	2023	103.0 kg/m^2
10 mm Tar Board (Building Products)	10	56	2.8 kg/m^2
131 mm CLT 5-ply	131	1338	67.0 kg/m^2
Total	**179**	**3417**	**173 kg/m^2**

Test Specimen Installation

- The exposed area of the floor specimen used for the calculations of the airborne sound transmission loss was 17.85 m^2 (4.71 m x 3.79 m).
- The total area of the floor assembly resting on top of the lip was 19.32 m^2 (4.88 m x 3.96 m).
- The mass per area of the elements above the lip was calculated using the total area (19.32 m^2).

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ASTM E90 Test Results – Airborne Sound Transmission Loss

Client: Nordic Engineered Wood **Test ID:** TLF-15-021

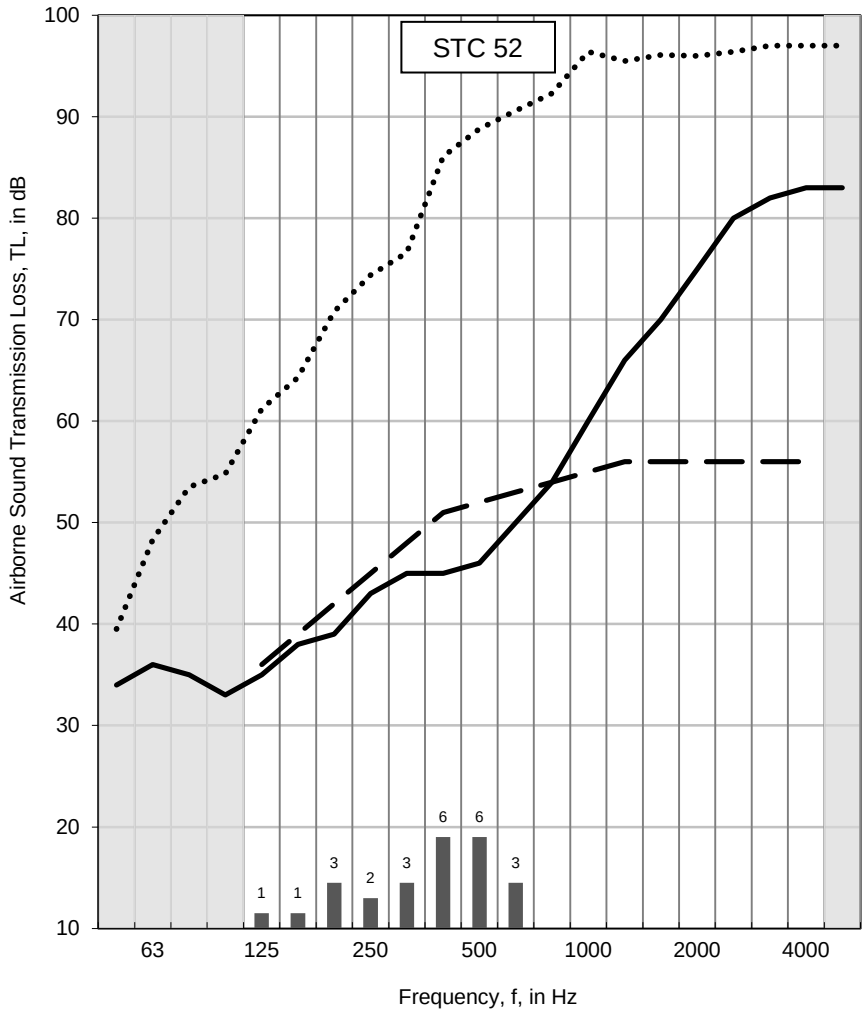
Specimen ID: A1-006070-23F **Date of Test:** March 26, 2015

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Upper	175.9	26.5 to 27.5	38.4 to 38.7
Lower	177.1	17.9 to 17.9	40.2 to 40.3

Area S of test specimen:	17.85 m^2
Mass per unit area:	173 kg/m^2

f (Hz)	Airborne TL (dB)
50	34
63	36
80	35
100	33
125	35
160	38
200	39
250	43
315	45
400	45
500	46
630	50
800	54
1000	60
1250	66
1600	70
2000	75
2500	80
3150	82
4000	83
5000	83
Sound Transmission Class (STC)	**52**

Sum of Deficiencies (dB)
25
Max. Deficiency (dB)
6 dB at 400 and 500 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Airborne sound transmission loss measurements were conducted in accordance with the requirements of ASTM E90-09, "Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements" with the exception that the temperature in the upper room was higher than 27ºC.**

In the graph:
The solid line is the measured sound transmission loss for this specimen. The dashed line is the STC contour fitted to the measured values according to ASTM E413-10. The dotted line (may be above the displayed range) is 10 dB below the flanking limit established for this facility. For any frequency band where the measured transmission loss is above the dotted line, the reported value is potentially limited by flanking transmission via laboratory surfaces, and the true value may be higher than that measured. Bars at the bottom of the graph show deficiencies where the measured data are less than the reference contour as described in the fitting procedure for the STC, defined in ASTM E413-10. The shaded cells in the table and areas in the graph are outside the STC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. The reported values have been corrected according to the procedure outlined in ASTM E90-09. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level, in which case, the corrected values provide an estimate of the lower limit of airborne sound transmission loss.

ASTM E492 Test Results – Normalized Impact Sound Pressure Levels

Client: Nordic Engineered Wood **Test ID:** IIF-15-018

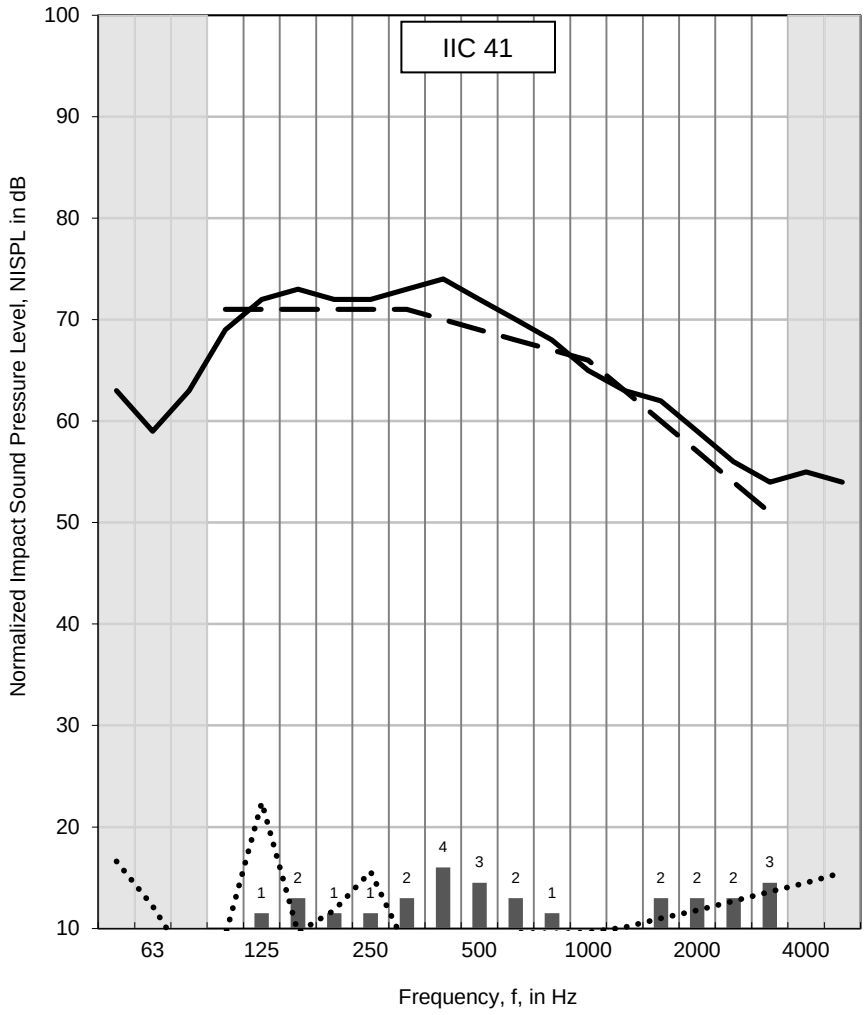
Specimen ID: A1-006070-23F **Date of Test:** March 25, 2015

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Upper	175.9	26.7 to 26.8	30.0 to 31.9
Lower	177.1	17.7 to 17.8	36.6 to 37.3

Area S of test specimen:	17.85 m^2
Mass per unit area:	173 kg/m^2

f (Hz)	NISPL (dB)
50	63
63	59
80	63
100	69
125	72
160	73
200	72
250	72
315	73
400	74
500	72
630	70
800	68
1000	65
1250	63
1600	62
2000	59
2500	56
3150	54
4000	55
5000	54
Impact Insulation Class (IIC)	**41**

Sum of Positive Differences (dB)
26
Max. Positive Difference (dB)
4 dB at 400 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Measurements of normalized impact sound pressure level (NISPL) were conducted in accordance with the requirements of ASTM E492-09, "Standard Laboratory Measurement of Impact Sound Transmission through Floor-Ceiling Assemblies Using the Tapping Machine".**

In the graph:
The solid line is the measured normalized impact sound pressure level (NISPL) for this specimen. The dashed line is the IIC contour fitted to the measured values according to ASTM E989-06. The dotted line is the background sound level measured in the receiving room during this test (may be below the displayed range). For any frequency where measured NISPL is less than 10 dB above the dotted line, the reported values were adjusted as noted below. Bars at bottom of graph show positive differences; where the measured data are greater than the reference contour as defined in ASTM E989-06. Shaded cells in the table and areas in the graph are outside the IIC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level and the reported values of NISPL provide an estimate of the upper limit of normalized impact sound pressure level, according to the procedure outlined in ASTM E492-09. The reported values of NISPL have been corrected according to the procedure outlined in ASTM E492-09.

Client Nordic Engineered Wood
1100 Ave des Canadiens-de-Montreal
Montreal QC H3B 2S2

Specimen Laminate floating floor on a 2 mm closed cell foam on 38 mm (1-1/2") precast concrete slab on 10 mm tar boards placed on top of a CLT 5 ply (175 mm).

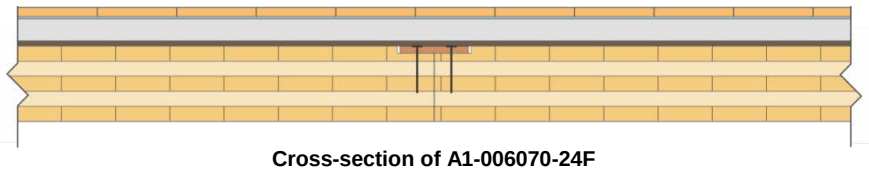
Specimen ID A1-006070-24F

Construction Date: March 26, 2015

Specimen Description

The specimen was composed of two cross-laminated timber (CLT) 5 ply (131 mm thick x 1989 mm wide x 4872 mm long) panels with a butt joint in the middle of the floor. The combined panels filled the entire floor opening of the test frame. The two CLT panels were joined using a 120 mm wide x 12 mm thick plywood strip spanning the full joint (4.9 m). The plywood strip was nailed with common nails 75 mm (3") long spaced 305 mm (12") on centre along the joint with beads of PL premium adhesive between the plywood strip and the CLT panels. The CLT floor was resting on the lip of the test frame and was not fastened to the test frame. The air gaps between the edges of the CLT floor and the test frame were filled with glass fiber insulation and covered with cloth tape. Duct putty was installed around the lower perimeter of the test frame and the CLT.

Laminate floating floor (9 mm thick) was installed on top of a 2 mm Roberts® Soft Stride closed cell foam which was placed on top of a 38 mm (1-1/2") precast concrete slab. The 38 mm precast concrete slab was placed on top of 10 mm tar boards which were placed on the CLT floor.



Cross-section of A1-006070-24F

Specimen Properties

Element	Actual thickness (mm)	Mass (kg)	Mass/length, area or volume
9 mm Generic Engineered Floating Floor	9	172	8.6 kg/m^2
2 mm Roberts® Soft Stride Closed Cell Foam	2	2.5	0.1 kg/m^2
38 mm Precast Concrete Slab	38	2023	103.0 kg/m^2
10 mm Tar Board (Building Products)	10	56	2.8 kg/m^2
131 mm CLT 5-ply	131	1338	67.0 kg/m^2
Total	**190**	**3592**	**182 kg/m^2**

Test Specimen Installation

- The exposed area of the floor specimen used for the calculations of the airborne sound transmission loss was 17.85 m^2 (4.71 m x 3.79 m).
- The total area of the floor assembly resting on top of the lip was 19.32 m^2 (4.88 m x 3.96 m).
- The mass per area of the elements above the lip was calculated using the total area (19.32 m^2).

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ASTM E90 Test Results – Airborne Sound Transmission Loss

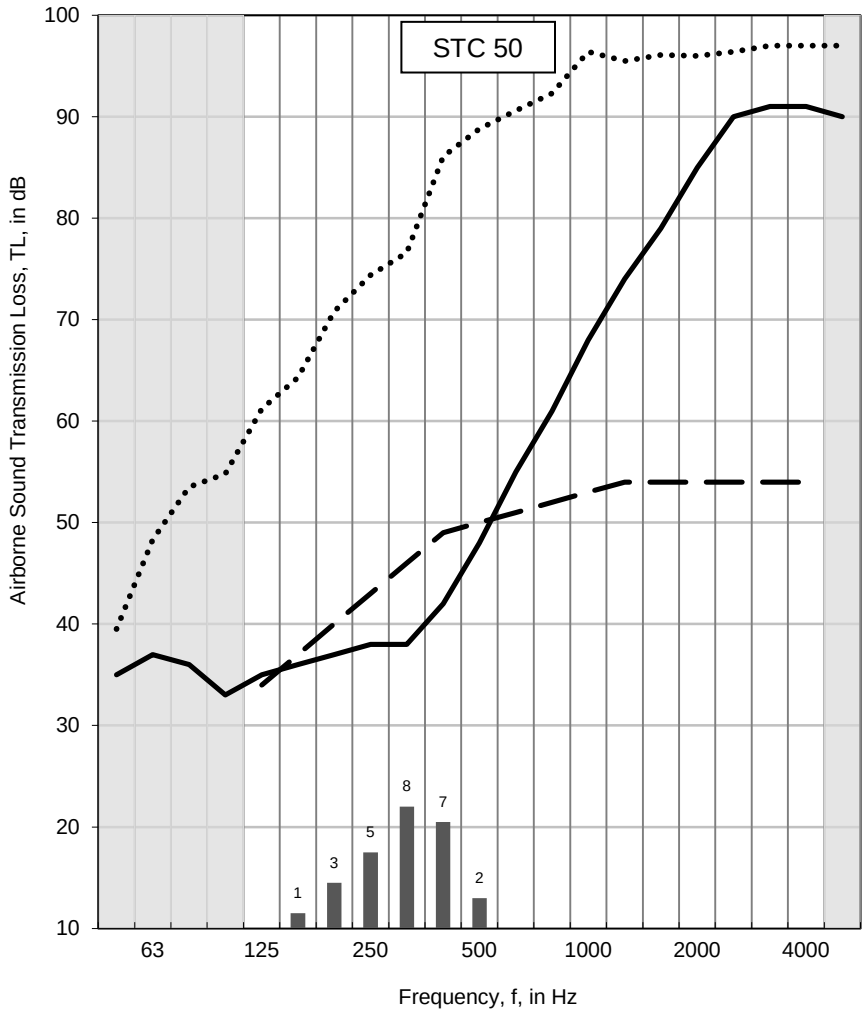
Client: Nordic Engineered Wood **Test ID:** TLF-15-022

Specimen ID: A1-006070-24F **Date of Test:** March 26, 2015

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Upper	175.5	25.4 to 25.5	39.0 to 39.9
Lower	177.1	17.8 to 17.8	40.6 to 40.7

Area S of test specimen:	17.85 m^2
Mass per unit area:	182 kg/m^2

f (Hz)	Airborne TL (dB)	
50	35	
63	37	
80	36	
100	33	
125	35	
160	36	
200	37	
250	38	
315	38	
400	42	
500	48	
630	55	
800	61	
1000	68	
1250	74	
1600	79	
2000	85	
2500	90	c
3150	91	c
4000	91	c
5000	90	c
Sound Transmission Class (STC)	**50**	



Sum of Deficiencies (dB)
26
Max. Deficiency (dB)
8 dB at 315 Hz

For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Airborne sound transmission loss measurements were conducted in accordance with the requirements of ASTM E90-09, "Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements".**

In the graph:
The solid line is the measured sound transmission loss for this specimen. The dashed line is the STC contour fitted to the measured values according to ASTM E413-10. The dotted line (may be above the displayed range) is 10 dB below the flanking limit established for this facility. For any frequency band where the measured transmission loss is above the dotted line, the reported value is potentially limited by flanking transmission via laboratory surfaces, and the true value may be higher than that measured. Bars at the bottom of the graph show deficiencies where the measured data are less than the reference contour as described in the fitting procedure for the STC, defined in ASTM E413-10. The shaded cells in the table and areas in the graph are outside the STC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. The reported values have been corrected according to the procedure outlined in ASTM E90-09. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level, in which case, the corrected values provide an estimate of the lower limit of airborne sound transmission loss.

ASTM E492 Test Results – Normalized Impact Sound Pressure Levels

Client: Nordic Engineered Wood **Test ID:** IIF-15-019

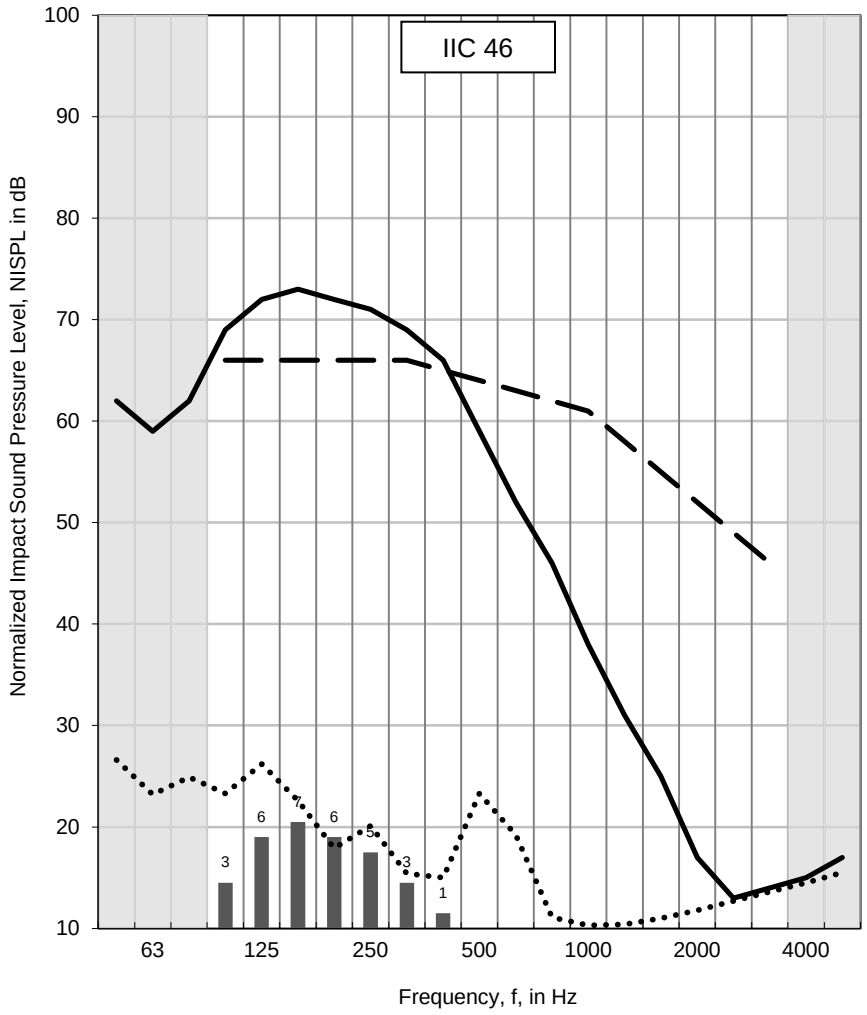
Specimen ID: A1-006070-24F **Date of Test:** March 26, 2015

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Upper	175.5	25.9 to 26.3	40.9 to 45.5
Lower	177.1	17.8 to 17.9	40.4 to 40.5

Area S of test specimen:	17.85 m^2
Mass per unit area:	182 kg/m^2

f (Hz)	NISPL (dB)	
50	62	
63	59	
80	62	
100	69	
125	72	
160	73	
200	72	
250	71	
315	69	
400	66	
500	59	
630	52	
800	46	
1000	38	
1250	31	
1600	25	c
2000	17	*
2500	13	*
3150	14	*
4000	15	*
5000	17	*
Impact Insulation Class (IIC)	**46**	

Sum of Positive Differences (dB)
31
Max. Positive Difference (dB)
7 dB at 160 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Measurements of normalized impact sound pressure level (NISPL) were conducted in accordance with the requirements of ASTM E492-09, "Standard Laboratory Measurement of Impact Sound Transmission through Floor-Ceiling Assemblies Using the Tapping Machine".**

In the graph:
The solid line is the measured normalized impact sound pressure level (NISPL) for this specimen. The dashed line is the IIC contour fitted to the measured values according to ASTM E989-06. The dotted line is the background sound level measured in the receiving room during this test (may be below the displayed range). For any frequency where measured NISPL is less than 10 dB above the dotted line, the reported values were adjusted as noted below. Bars at bottom of graph show positive differences; where the measured data are greater than the reference contour as defined in ASTM E989-06. Shaded cells in the table and areas in the graph are outside the IIC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level and the reported values of NISPL provide an estimate of the upper limit of normalized impact sound pressure level, according to the procedure outlined in ASTM E492-09. The reported values of NISPL have been corrected according to the procedure outlined in ASTM E492-09.

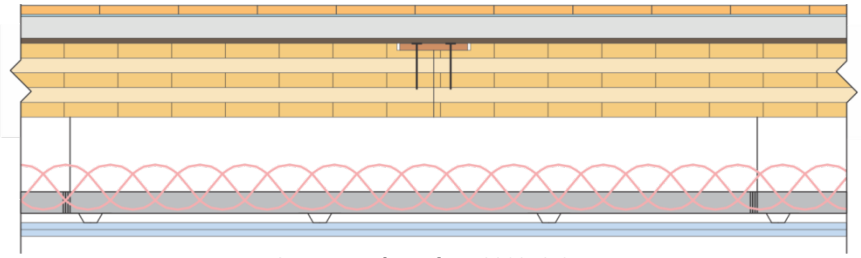
Client	Nordic Engineered Wood 1100 Ave des Canadiens-de-Montreal Montreal QC H3B 2S2
Specimen	Laminate floating floor on 3 mm premium felt on 38 mm (1-1/2”) precast concrete slab on 9 mm closed cell foam placed on top of a CLT 5 ply (131 mm) with two layers of 13 mm Type C gypsum board installed on a hung ceiling grid.
Specimen ID	A1-006070-25F
Construction Date:	March 31, 2015 to April 2, 2015

Specimen Description

The specimen was composed of two cross-laminated timber (CLT) 5 ply (131 mm thick x 1989 mm wide x 4872 mm long) panels with a butt joint in the middle of the floor. The combined panels filled the entire floor opening of the test frame. The two CLT panels were joined using a 120 mm wide x 12 mm thick plywood strip spanning the full joint (4.9 m). The plywood strip was nailed with common nails 75 mm (3”) long spaced 305 mm (12”) on centre along the joint with beads of PL premium adhesive between the plywood strip and the CLT panels. The CLT floor was resting on the lip of the test frame and was not fastened to the test frame. The air gaps between the edges of the CLT floor and the test frame were filled with glass fiber insulation and covered with cloth tape. Duct putty was installed around the lower perimeter of the test frame and the CLT.

Laminate floating floor (9 mm thick) was installed on top of a 3 mm Acoustic-Tech™ Premium Felt Membrane which was placed on top of a 38 mm (1-1/2”) precast concrete slab. The 38 mm precast concrete slab was placed on top of 10 mm tar boards which was placed on the CLT floor.

For the hung ceiling, two layers of 13 mm (5/8”) Type C gypsum board were installed on 22 mm (7/8”) furring channels. The base layer of gypsum board was attached using 41 mm (1-5/8") long type S screws spaced 305 mm (12”) on centre on every furring channel. The face layer was staggered from the base later and attached using 50 mm (2") long type S screws spaced 305 mm (12”) on centre on every furring channel. The exposed gypsum board joints were caulked and taped. The furring channels were attached perpendicularly to the 38 mm (1-1/2”) C-channels at a spacing of 406 mm (16”) on centre with wire. The C-channels were attached to the CLT using standard ceiling wire and angles which were screwed into the CLT. The C-channels were spaced 1220 mm (4’) on centre and hung with a space of 145 mm (6”) from the top of the C-channels to the underside the CLT with 92 mm (3-5/8”) Owens Corning EcoTouch Fiberglas® Batts in the cavity. The total hung ceiling depth was 230 mm (9”).



Cross-section of A1-006070-25F

Specimen Properties

Element	Actual thickness (mm)	Mass (kg)	Mass/length, area or volume
9 mm Generic Laminate Floating Floor	9	172	8.6 kg/m^2
3 mm Acoustic-Tech^{TM} Premium Felt Membrane	3	9.5	0.5 kg/m^2
38 mm Precast Concrete Slab	38	2023	103.0 kg/m^2
10 mm Tar Board (Building Products)	10	56	2.8 kg/m^2
131 mm CLT 5-ply	131	1338	67.0 kg/m^2
Standard Ceiling Wire + Angles	145	-	- -
92 mm OC EcoTouch Pink Fiberglas® Batts	92*	29	1.5 kg/m^2
38 mm (1-1/2") C-Channels	38	9	0.5 kg/m
22 mm (7/8”) Furring Channels	22	9	0.2 kg/m
13 mm Type C Gypsum Board	13	177	10.0 kg/m^2
13 mm Type C Gypsum Board	13	177	10.0 kg/m^2
Total	**422**	**4000**	**204 kg/m^2**

***** The thickness of the insulation batts is not included in the total specimen thickness.

Test Specimen Installation

- The exposed area of the floor specimen used for the calculations of the airborne sound transmission loss was 17.85 m^2 (4.71 m x 3.79 m).
- The total area of the floor assembly resting on top of the lip was 19.32 m^2 (4.88 m x 3.96 m).
- The mass per area of the elements above the lip was calculated using the total area (19.32 m^2) and the mass per area of the elements below the lip was calculated using the exposed area (17.85 m^2).

ASTM E90 Test Results – Airborne Sound Transmission Loss

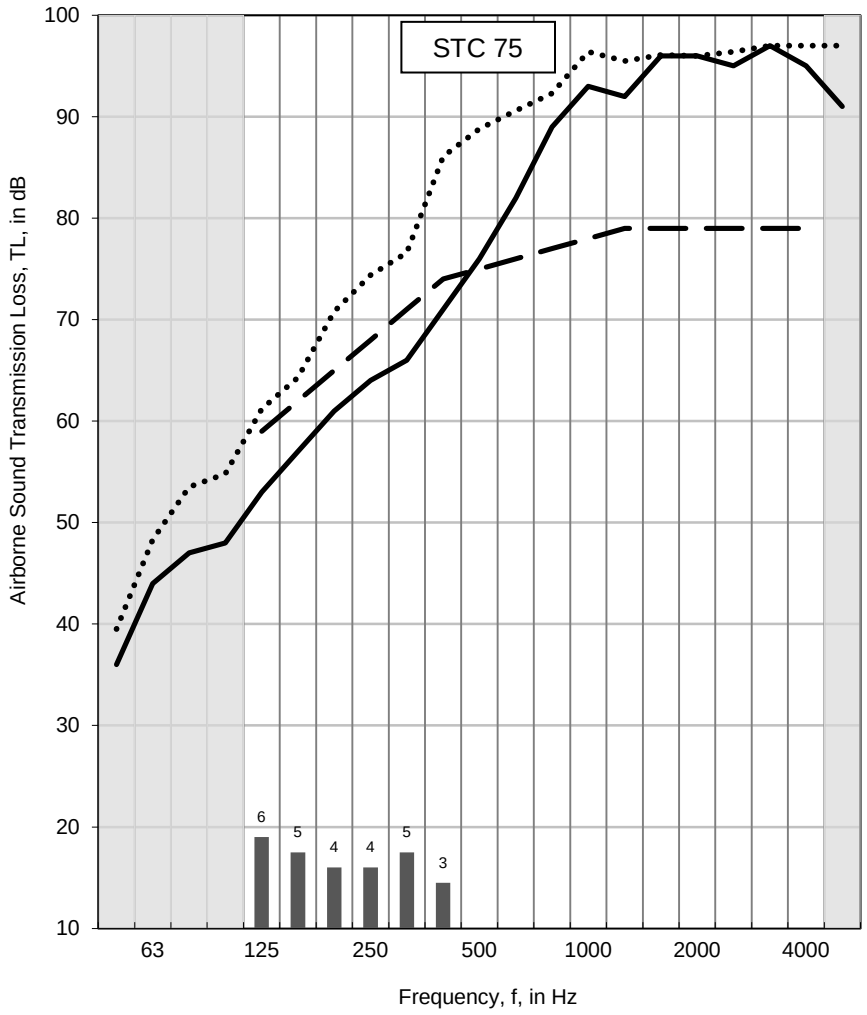
Client: Nordic Engineered Wood **Test ID:** TLF-15-024

Specimen ID: A1-006070-25F **Date of Test:** April 7, 2015

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Upper	175.5	20.6 to 20.7	35.0 to 35.1
Lower	173.0	17.6 to 17.6	40.3 to 40.4

Area S of test specimen:	17.85 m^2
Mass per unit area:	204 kg/m^2

f (Hz)	Airborne TL (dB)	
50	36	
63	44	
80	47	
100	48	
125	53	
160	57	
200	61	
250	64	
315	66	
400	71	
500	76	c
630	82	
800	89	c
1000	93	*
1250	92	*
1600	96	*
2000	96	*
2500	95	*
3150	97	*
4000	95	*
5000	91	c
Sound Transmission Class (STC)	**75**	



Sum of Deficiencies (dB)
27
Max. Deficiency (dB)
6 dB at 125 Hz

For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Airborne sound transmission loss measurements were conducted in accordance with the requirements of ASTM E90-09, "Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements".**

In the graph:
The solid line is the measured sound transmission loss for this specimen. The dashed line is the STC contour fitted to the measured values according to ASTM E413-10. The dotted line (may be above the displayed range) is 10 dB below the flanking limit established for this facility. For any frequency band where the measured transmission loss is above the dotted line, the reported value is potentially limited by flanking transmission via laboratory surfaces, and the true value may be higher than that measured. Bars at the bottom of the graph show deficiencies where the measured data are less than the reference contour as described in the fitting procedure for the STC, defined in ASTM E413-10. The shaded cells in the table and areas in the graph are outside the STC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. The reported values have been corrected according to the procedure outlined in ASTM E90-09. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level, in which case, the corrected values provide an estimate of the lower limit of airborne sound transmission loss.

ASTM E492 Test Results – Normalized Impact Sound Pressure Levels

Client: Nordic Engineered Wood **Test ID:** IIF-15-020

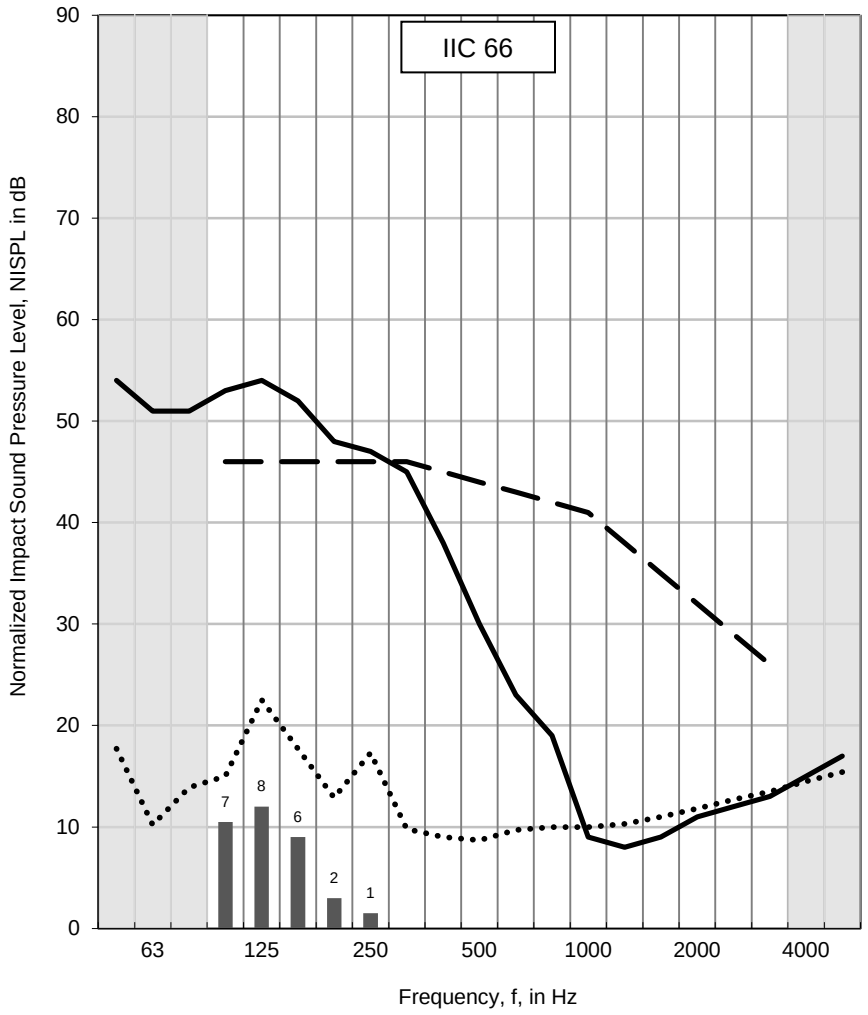
Specimen ID: A1-006070-25F **Date of Test:** April 7, 2015

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Upper	175.5	20.7 to 21.0	33.5 to 34.6
Lower	173.0	17.6 to 17.7	40.3 to 40.4

Area S of test specimen:	17.85 m^2
Mass per unit area:	204 kg/m^2

f (Hz)	NISPL (dB)	
50	54	
63	51	
80	51	
100	53	
125	54	
160	52	
200	48	
250	47	
315	45	
400	38	
500	30	
630	23	
800	19	c
1000	9	*
1250	8	*
1600	9	*
2000	11	*
2500	12	*
3150	13	*
4000	15	*
5000	17	*
Impact Insulation Class (IIC)	**66**	

Sum of Positive Differences (dB)
24
Max. Positive Difference (dB)
8 dB at 125 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Measurements of normalized impact sound pressure level (NISPL) were conducted in accordance with the requirements of ASTM E492-09, "Standard Laboratory Measurement of Impact Sound Transmission through Floor-Ceiling Assemblies Using the Tapping Machine".**

In the graph:
The solid line is the measured normalized impact sound pressure level (NISPL) for this specimen. The dashed line is the IIC contour fitted to the measured values according to ASTM E989-06. The dotted line is the background sound level measured in the receiving room during this test (may be below the displayed range). For any frequency where measured NISPL is less than 10 dB above the dotted line, the reported values were adjusted as noted below. Bars at bottom of graph show positive differences; where the measured data are greater than the reference contour as defined in ASTM E989-06. Shaded cells in the table and areas in the graph are outside the IIC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level and the reported values of NISPL provide an estimate of the upper limit of normalized impact sound pressure level, according to the procedure outlined in ASTM E492-09. The reported values of NISPL have been corrected according to the procedure outlined in ASTM E492-09.

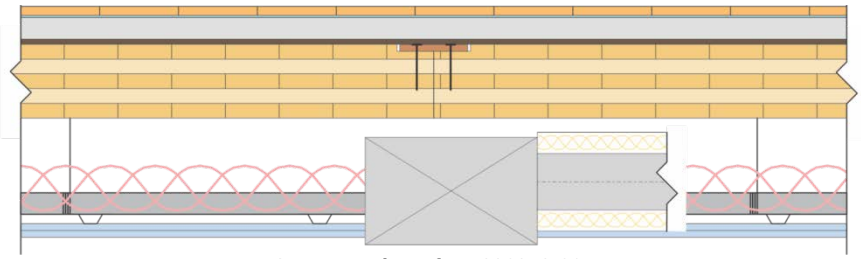
Client	Nordic Engineered Wood 1100 Ave des Canadiens-de-Montreal Montreal QC H3B 2S2
Specimen	9 mm engineered floating floor on 3 mm premium felt on 38 mm (1-1/2”) precast concrete slab on 9 mm closed cell foam placed on top of a CLT 5 ply (131 mm) with two layers of 13 mm Type C gypsum board installed on a hung ceiling grid with a ventilation box and flexible vent installed in the ceiling cavity.
Specimen ID	A1-006070-26F
Construction Date:	April 10, 2015 to April 13, 2015

Specimen Description

The specimen was composed of two cross-laminated timber (CLT) 5 ply (131 mm thick x 1989 mm wide x 4872 mm long) panels with a butt joint in the middle of the floor. The combined panels filled the entire floor opening of the test frame. The two CLT panels were joined using a 120 mm wide x 12 mm thick plywood strip spanning the full joint (4.9 m). The plywood strip was nailed with common nails 75 mm (3”) long spaced 305 mm (12”) on centre along the joint with beads of PL premium adhesive between the plywood strip and the CLT panels. The CLT floor was resting on the lip of the test frame and was not fastened to the test frame. The air gaps between the edges of the CLT floor and the test frame were filled with glass fiber insulation and covered with cloth tape. Duct putty was installed around the lower perimeter of the test frame and the CLT.

Laminate floating floor (9 mm thick) was installed on top of a 3 mm Acoustic-Tech™ Premium Felt Membrane which was placed on top of a 38 mm (1-1/2”) precast concrete slab. The 38 mm precast concrete slab was placed on top of 10 mm tar boards which was placed on the CLT floor.

For the hung ceiling, two layers of 13 mm (5/8”) Type C gypsum board were installed on 22 mm (7/8”) furring channels. The base layer of gypsum board was attached using 41 mm (1-5/8") long type S screws spaced 305 mm (12”) on centre on every furring channel. The face layer was staggered from the base later and attached using 50 mm (2") long type S screws spaced 305 mm (12”) on centre on every furring channel. The exposed gypsum board joints were caulked and taped. The furring channels were attached perpendicularly to the 38 mm (1-1/2”) C-channels at a spacing of 406 mm (16”) on centre with wire. The C-channels were attached to the CLT using standard ceiling wire and angles which were screwed into the CLT. The C-channels were spaced 1220 mm (4’) on centre and hung with a space of 145 mm (6”) from the top of the C-channels to the underside the CLT with 92 mm (3-5/8”) Owens Corning EcoTouch Fiberglas® Batts in the cavity. In the middle of the ceiling, a 305 mm (12”) square x 150 mm (6”) deep vent box connected with a 100 mm (4”) flexible duct 3050 mm (10’) long was attached to metal supports and not touching the CLT. The total hung ceiling depth was 230 mm (9”).



Cross-section of A1-006070-26F

Specimen Properties

Element	Actual thickness (mm)	Mass (kg)	Mass/length, area or volume
9 mm Generic Laminate Floating Floor	9	172	8.6 kg/m^2
3 mm Acoustic-Tech^{TM} Premium Felt Membrane	3	9.5	0.5 kg/m^2
38 mm Precast Concrete Slab	38	2023	103.0 kg/m^2
10 mm Tar Board (Building Products)	10	56	2.8 kg/m^2
131 mm CLT 5-ply	131	1338	67.0 kg/m^2
Standard Ceiling Wire + Angles	145	-	- -
92 mm OC EcoTouch Pink Fiberglas® Batts	92*	29	1.5 kg/m^2
38 mm (1-1/2") C-Channels	38	9	0.5 kg/m
22 mm (7/8”) Furring Channels	22	9	0.2 kg/m
305 mm Square x 150 mm Deep Vent Box	150*	2	2.0 kg/ea
100 mm Interior Diameter Flexible Insulated Duct	150*	1	0.3 kg/m
13 mm Type C Gypsum Board	13	177	10.0 kg/m^2
13 mm Type C Gypsum Board	13	177	10.0 kg/m^2
Total	**422**	**4003**	**204 kg/m^2**

***** The thickness of the insulation batts, vent box and flexible vent are not included in the total specimen thickness.

Test Specimen Installation

- The exposed area of the floor specimen used for the calculations of the airborne sound transmission loss was 17.85 m^2 (4.71 m x 3.79 m).
- The total area of the floor assembly resting on top of the lip was 19.32 m^2 (4.88 m x 3.96 m).
- The mass per area of the elements above the lip was calculated using the total area (19.32 m^2) and the mass per area of the elements below the lip was calculated using the exposed area (17.85 m^2).

ASTM E90 Test Results – Airborne Sound Transmission Loss

Client: Nordic Engineered Wood **Test ID:** TLF-15-025

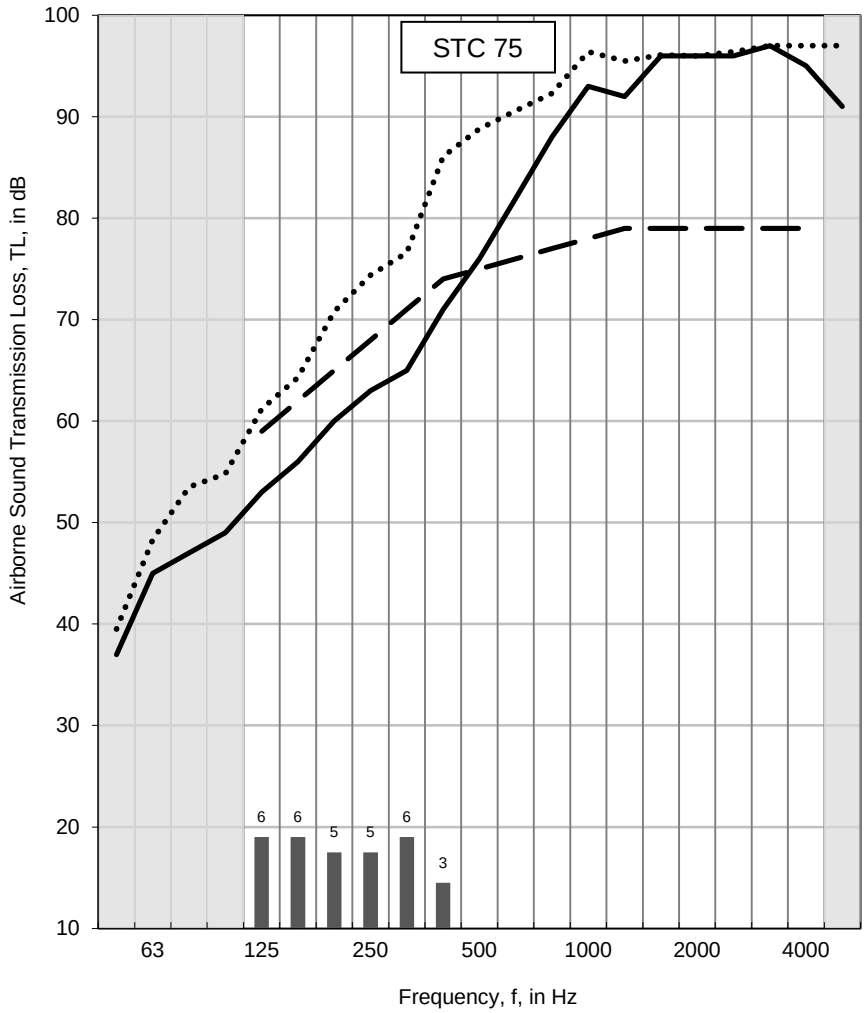
Specimen ID: A1-006070-26F **Date of Test:** April 13, 2015

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Upper	175.5	20.8 to 21.0	33.3 to 33.6
Lower	173.0	17.8 to 17.9	35.4 to 35.5

Area S of test specimen:	17.85 m^2
Mass per unit area:	204 kg/m^2

f (Hz)	Airborne TL (dB)	
50	37	
63	45	
80	47	
100	49	
125	53	
160	56	
200	60	
250	63	
315	65	
400	71	
500	76	
630	82	
800	88	c
1000	93	c
1250	92	c
1600	96	*
2000	96	*
2500	96	*
3150	97	*
4000	95	*
5000	91	c
Sound Transmission Class (STC)	**75**	

Sum of Deficiencies (dB)
31
Max. Deficiency (dB)
6 dB at 125, 160 and 315 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Airborne sound transmission loss measurements were conducted in accordance with the requirements of ASTM E90-09, "Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements".**

In the graph:
The solid line is the measured sound transmission loss for this specimen. The dashed line is the STC contour fitted to the measured values according to ASTM E413-10. The dotted line (may be above the displayed range) is 10 dB below the flanking limit established for this facility. For any frequency band where the measured transmission loss is above the dotted line, the reported value is potentially limited by flanking transmission via laboratory surfaces, and the true value may be higher than that measured. Bars at the bottom of the graph show deficiencies where the measured data are less than the reference contour as described in the fitting procedure for the STC, defined in ASTM E413-10. The shaded cells in the table and areas in the graph are outside the STC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. The reported values have been corrected according to the procedure outlined in ASTM E90-09. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level, in which case, the corrected values provide an estimate of the lower limit of airborne sound transmission loss.

ASTM E492 Test Results – Normalized Impact Sound Pressure Levels

Client: Nordic Engineered Wood **Test ID:** IIF-15-022

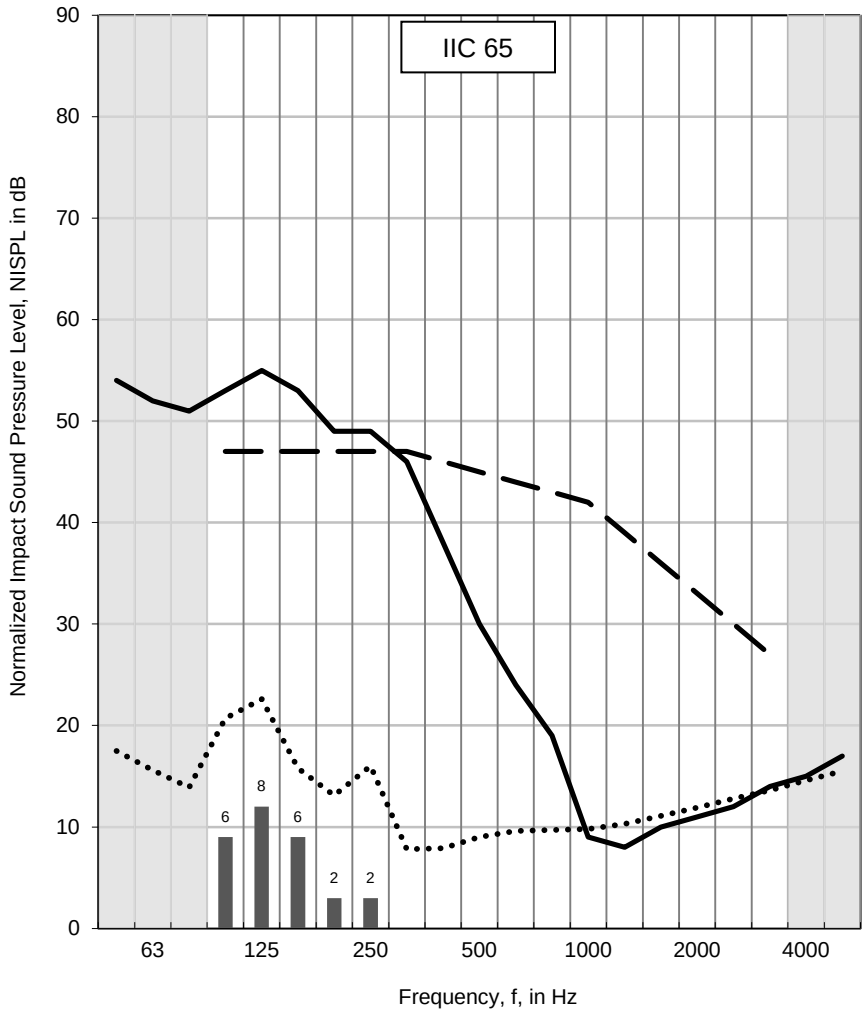
Specimen ID: A1-006070-26F **Date of Test:** April 15, 2015

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Upper	175.5	24.6 to 24.9	21.3 to 26.9
Lower	173.0	18.8 to 18.8	37.3 to 37.4

Area S of test specimen:	17.85 m^2
Mass per unit area:	204 kg/m^2

f (Hz)	NISPL (dB)	
50	54	
63	52	
80	51	
100	53	
125	55	
160	53	
200	49	
250	49	
315	46	
400	38	
500	30	
630	24	
800	19	c
1000	9	*
1250	8	*
1600	10	*
2000	11	*
2500	12	*
3150	14	*
4000	15	*
5000	17	*
Impact Insulation Class (IIC)	**65**	

Sum of Positive Differences (dB)
24
Max. Positive Difference (dB)
8 dB at 125 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Measurements of normalized impact sound pressure level (NISPL) were conducted in accordance with the requirements of ASTM E492-09, "Standard Laboratory Measurement of Impact Sound Transmission through Floor-Ceiling Assemblies Using the Tapping Machine".**

In the graph:
The solid line is the measured normalized impact sound pressure level (NISPL) for this specimen. The dashed line is the IIC contour fitted to the measured values according to ASTM E989-06. The dotted line is the background sound level measured in the receiving room during this test (may be below the displayed range). For any frequency where measured NISPL is less than 10 dB above the dotted line, the reported values were adjusted as noted below. Bars at bottom of graph show positive differences; where the measured data are greater than the reference contour as defined in ASTM E989-06. Shaded cells in the table and areas in the graph are outside the IIC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level and the reported values of NISPL provide an estimate of the upper limit of normalized impact sound pressure level, according to the procedure outlined in ASTM E492-09. The reported values of NISPL have been corrected according to the procedure outlined in ASTM E492-09.

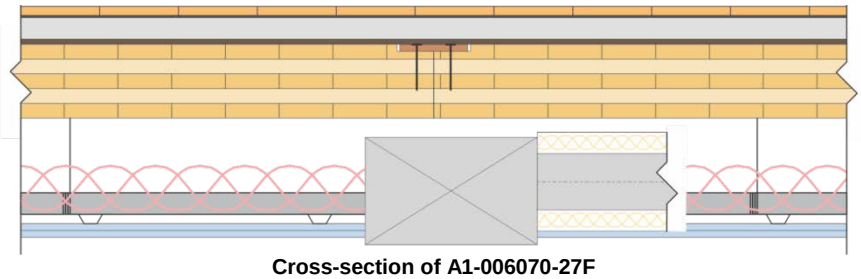
Client	Nordic Engineered Wood 1100 Ave des Canadiens-de-Montreal Montreal QC H3B 2S2
Specimen	Laminate floating floor on 3 mm rubber membrane on 38 mm (1-1/2”) precast concrete slab on 9 mm closed cell foam placed on top of a CLT 5 ply (131 mm) with two layers of 13 mm Type C gypsum board installed on a hung ceiling grid with a ventilation box and flexible vent installed in the ceiling cavity.
Specimen ID	A1-006070-27F
Construction Date:	April 15, 2015

Specimen Description

The specimen was composed of two cross-laminated timber (CLT) 5 ply (131 mm thick x 1989 mm wide x 4872 mm long) panels with a butt joint in the middle of the floor. The combined panels filled the entire floor opening of the test frame. The two CLT panels were joined using a 120 mm wide x 12 mm thick plywood strip spanning the full joint (4.9 m). The plywood strip was nailed with common nails 75 mm (3”) long spaced 305 mm (12”) on centre along the joint with beads of PL premium adhesive between the plywood strip and the CLT panels. The CLT floor was resting on the lip of the test frame and was not fastened to the test frame. The air gaps between the edges of the CLT floor and the test frame were filled with glass fiber insulation and covered with cloth tape. Duct putty was installed around the lower perimeter of the test frame and the CLT.

Laminate floating floor (9 mm thick) was installed installed on top of a 3 mm Insonobois rubber membrane which was placed on top of a 38 mm (1-1/2”) precast concrete slab. The 38 mm precast concrete slab was placed on top of 10 mm tar boards which was placed on the CLT floor.

For the hung ceiling, two layers of 13 mm (5/8”) Type C gypsum board were installed on 22 mm (7/8”) furring channels. The base layer of gypsum board was attached using 41 mm (1-5/8") long type S screws spaced 305 mm (12”) on centre on every furring channel. The face layer was staggered from the base later and attached using 50 mm (2") long type S screws spaced 305 mm (12”) on centre on every furring channel. The exposed gypsum board joints were caulked and taped. The furring channels were attached perpendicularly to the 38 mm (1-1/2”) C-channels at a spacing of 406 mm (16”) on centre with wire. The C-channels were attached to the CLT using standard ceiling wire and angles which were screwed into the CLT. The C-channels were spaced 1220 mm (4’) on centre and hung with a space of 145 mm (6”) from the top of the C-channels to the underside the CLT with 92 mm (3-5/8”) Owens Corning EcoTouch Fiberglas® Batts in the cavity. In the middle of the ceiling, a 305 mm (12”) square x 150 mm (6”) deep vent box connected with a 100 mm (4”) flexible duct 3050 mm (10’) long was attached to metal supports and not touching the CLT. The total hung ceiling depth was 230 mm (9”).



Cross-section of A1-006070-27F

Specimen Properties

Element	Actual thickness (mm)	Mass (kg)	Mass/length, area or volume
9 mm Generic Laminate Floating Floor	9	172	8.6 kg/m^2
3 mm Insonobois Rubber Membrane	3	36	1.8 kg/m^2
38 mm Precast Concrete Slab	38	2023	103.0 kg/m^2
10 mm Tar Board (Building Products)	10	56	2.8 kg/m^2
131 mm CLT 5-ply	131	1338	67.0 kg/m^2
Standard Ceiling Wire + Angles	145	-	- -
92 mm OC EcoTouch Pink Fiberglas® Batts	92*	29	1.5 kg/m^2
38 mm (1-1/2") C-Channels	38	9	0.5 kg/m
22 mm (7/8") Furring Channels	22	9	0.2 kg/m
305 mm Square x 150 mm Deep Vent Box	150*	2	2.0 kg/ea
100 mm Interior Diameter Flexible Insulated Duct	150*	1	0.3 kg/m
13 mm Type C Gypsum Board	13	177	10.0 kg/m^2
13 mm Type C Gypsum Board	13	177	10.0 kg/m^2
Total	**422**	**4029**	**206 kg/m^2**

Test Specimen Installation

- The exposed area of the floor specimen used for the calculations of the airborne sound transmission loss was 17.85 m^2 (4.71 m x 3.79 m).
- The total area of the floor assembly resting on top of the lip was 19.32 m^2 (4.88 m x 3.96 m).
- The mass per area of the elements above the lip was calculated using the total area (19.32 m^2) and the mass per area of the elements below the lip was calculated using the exposed area (17.85 m^2).

ASTM E90 Test Results – Airborne Sound Transmission Loss

Client: Nordic Engineered Wood **Test ID:** TLF-15-027

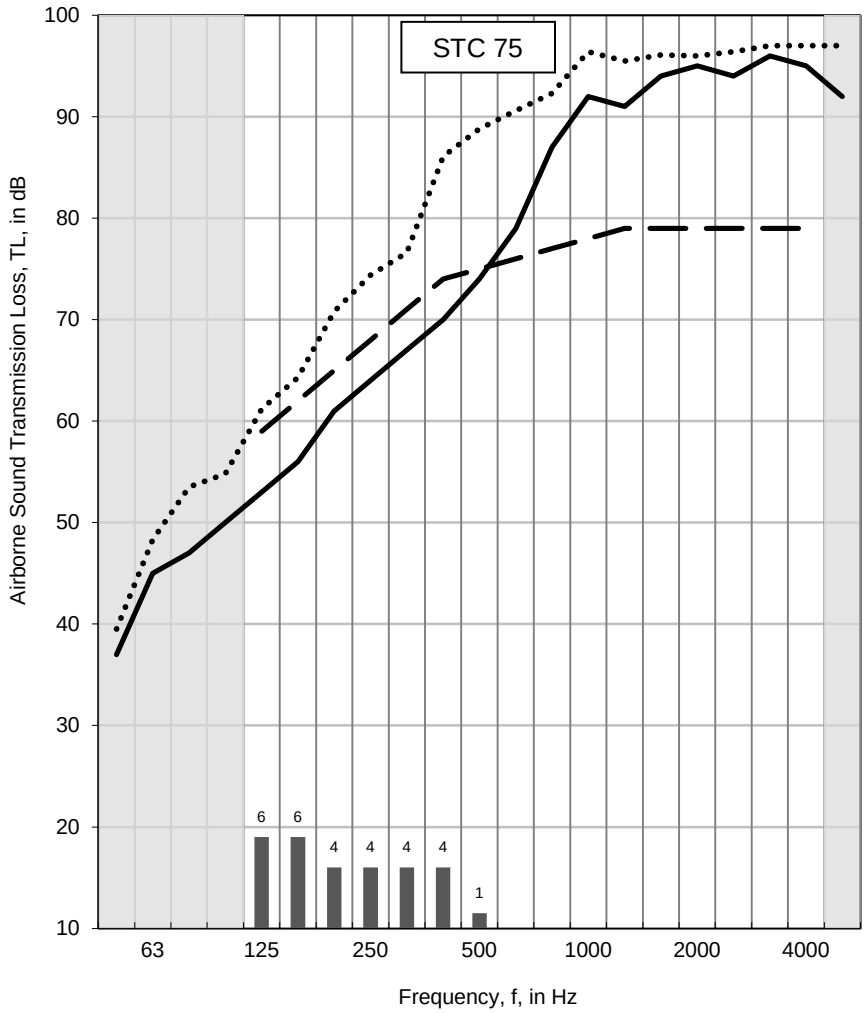
Specimen ID: A1-006070-27F **Date of Test:** April 17, 2015

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Upper	175.5	24.7 to 24.9	33.4 to 33.6
Lower	173.0	19.3 to 19.4	35.6 to 35.6

Area S of test specimen:	17.85 m^2
Mass per unit area:	206 kg/m^2

f (Hz)	Airborne TL (dB)	
50	37	*
63	45	*
80	47	*
100	50	*
125	53	c
160	56	*
200	61	*
250	64	*
315	67	*
400	70	*
500	74	*
630	79	*
800	87	*
1000	92	*
1250	91	*
1600	94	*
2000	95	*
2500	94	*
3150	96	*
4000	95	*
5000	92	c
Sound Transmission Class (STC)	**75**	

Sum of Deficiencies (dB)
29
Max. Deficiency (dB)
6 dB at 125 and 160 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Airborne sound transmission loss measurements were conducted in accordance with the requirements of ASTM E90-09, "Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements".**

In the graph:
The solid line is the measured sound transmission loss for this specimen. The dashed line is the STC contour fitted to the measured values according to ASTM E413-10. The dotted line (may be above the displayed range) is 10 dB below the flanking limit established for this facility. For any frequency band where the measured transmission loss is above the dotted line, the reported value is potentially limited by flanking transmission via laboratory surfaces, and the true value may be higher than that measured. Bars at the bottom of the graph show deficiencies where the measured data are less than the reference contour as described in the fitting procedure for the STC, defined in ASTM E413-10. The shaded cells in the table and areas in the graph are outside the STC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. The reported values have been corrected according to the procedure outlined in ASTM E90-09. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level, in which case, the corrected values provide an estimate of the lower limit of airborne sound transmission loss.

ASTM E492 Test Results – Normalized Impact Sound Pressure Levels

Client: Nordic Engineered Wood **Test ID:** IIF-15-023

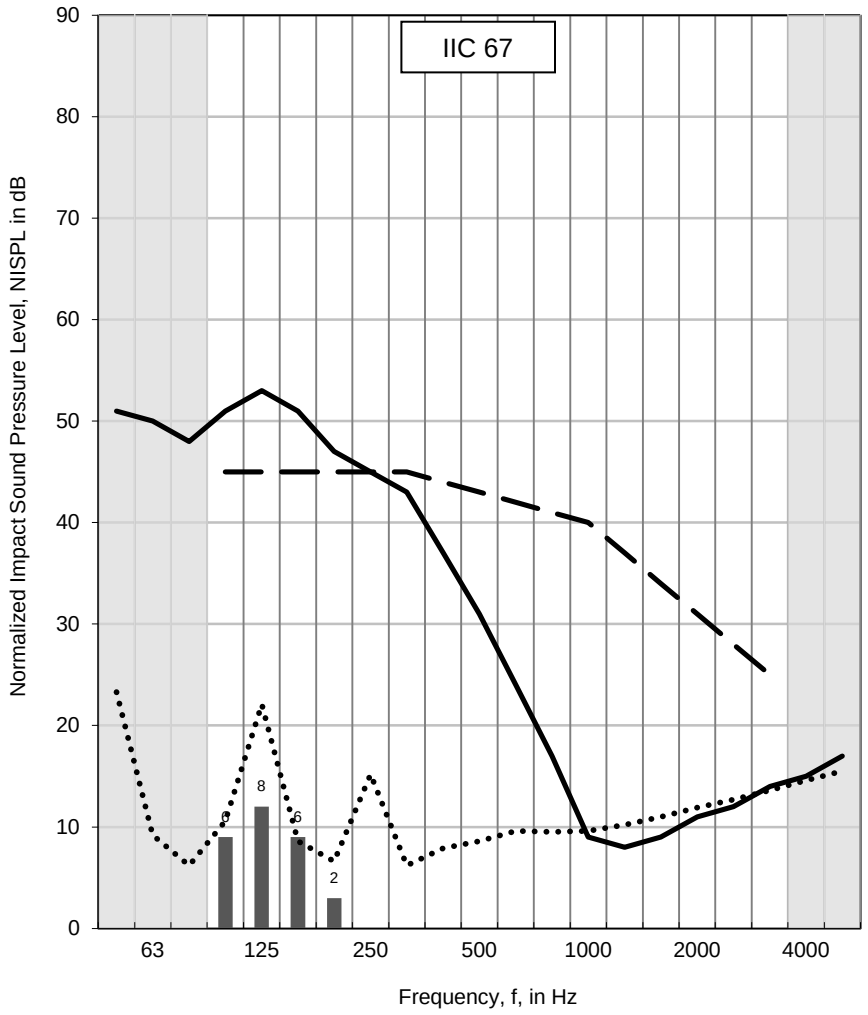
Specimen ID: A1-006070-27F **Date of Test:** April 16, 2015

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Upper	175.5	23.6 to 23.7	30.3 to 31.6
Lower	173.0	19.2 to 19.4	32.5 to 33.7

Area S of test specimen:	17.85 m^2
Mass per unit area:	206 kg/m^2

f (Hz)	NISPL (dB)	
50	51	
63	50	
80	48	
100	51	
125	53	
160	51	
200	47	
250	45	
315	43	
400	37	
500	31	
630	24	
800	17	c
1000	9	*
1250	8	*
1600	9	*
2000	11	*
2500	12	*
3150	14	*
4000	15	*
5000	17	*
Impact Insulation Class (IIC)	**67**	

Sum of Positive Differences (dB)
22
Max. Positive Difference (dB)
8 dB at 125 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Measurements of normalized impact sound pressure level (NISPL) were conducted in accordance with the requirements of ASTM E492-09, "Standard Laboratory Measurement of Impact Sound Transmission through Floor-Ceiling Assemblies Using the Tapping Machine".**

In the graph:
The solid line is the measured normalized impact sound pressure level (NISPL) for this specimen. The dashed line is the IIC contour fitted to the measured values according to ASTM E989-06. The dotted line is the background sound level measured in the receiving room during this test (may be below the displayed range). For any frequency where measured NISPL is less than 10 dB above the dotted line, the reported values were adjusted as noted below. Bars at bottom of graph show positive differences; where the measured data are greater than the reference contour as defined in ASTM E989-06. Shaded cells in the table and areas in the graph are outside the IIC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level and the reported values of NISPL provide an estimate of the upper limit of normalized impact sound pressure level, according to the procedure outlined in ASTM E492-09. The reported values of NISPL have been corrected according to the procedure outlined in ASTM E492-09.

Client Nordic Engineered Wood
1100 Ave des Canadiens-de-Montreal
Montreal QC H3B 2S2

Specimen 50 mm (2") normal strength concrete poured on 10 mm tar boards placed on top of a CLT 5 ply (131 mm).

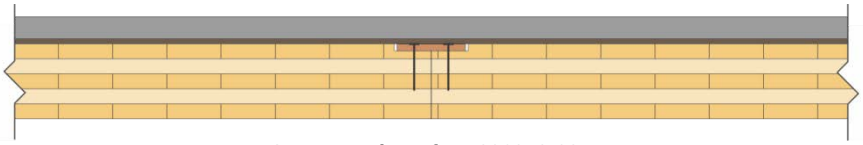
Specimen ID A1-006070-28F

Construction Date: April 28, 2015 to May 26, 2015

Specimen Description

The specimen was composed of two cross-laminated timber (CLT) 5 ply (131 mm thick x 1989 mm wide x 4872 mm long) panels with a butt joint in the middle of the floor. The combined panels filled the entire floor opening of the test frame. The two CLT panels were joined using a 120 mm wide x 12 mm thick plywood strip spanning the full joint (4.9 m). The plywood strip was nailed with common nails 75 mm (3") long spaced 305 mm (12") on centre along the joint with beads of PL premium adhesive between the plywood strip and the CLT panels. The CLT floor was resting on the lip of the test frame and was not fastened to the test frame. The air gaps between the edges of the CLT floor and the test frame were filled with glass fiber insulation and covered with cloth tape. Duct putty was installed around the lower perimeter of the test frame and the CLT.

50 mm (2") normal strength concrete was poured on a 0.1 mm (4 mils) polyethylene sheeting on top of 10 mm tar boards which were placed on the CLT floor.



Cross-section of A1-006070-28F

Specimen Properties

Element	Actual thickness (mm)	Mass (kg)	Mass/length, area or volume
50 mm Poured Concrete	50	2376	119.0 kg/m^2
10 mm Tar Board (Building Products)	10	56	2.8 kg/m^2
131 mm CLT 5-ply	131	1338	67.0 kg/m^2
Total	**191**	**3770**	**189 kg/m^2**

Test Specimen Installation

- The exposed area of the floor specimen used for the calculations of the airborne sound transmission loss was 17.85 m^2 (4.71 m x 3.79 m).
- The total area of the floor assembly resting on top of the lip was 19.32 m^2 (4.88 m x 3.96 m).
- The mass per area of the elements above the lip was calculated using the total area (19.32 m^2).

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ASTM E90 Test Results – Airborne Sound Transmission Loss

Client: Nordic Engineered Wood **Test ID:** TLF-15-039

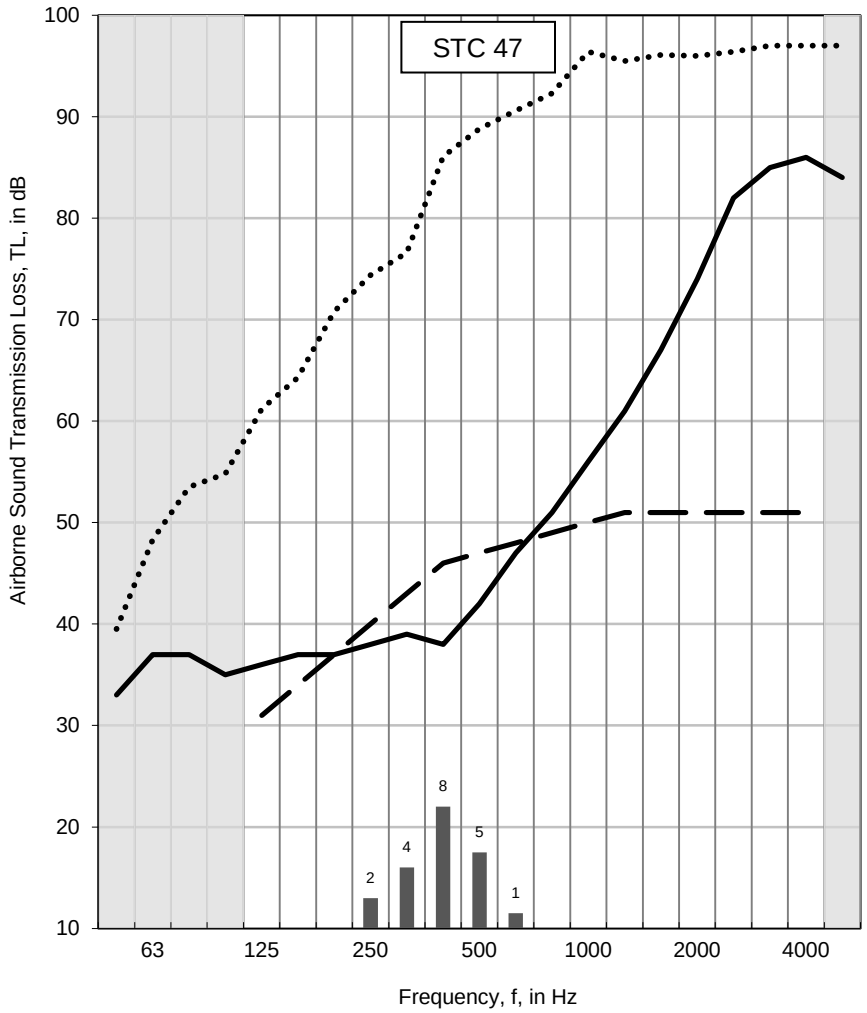
Specimen ID: A1-006070-28F **Date of Test:** May 27, 2015

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Upper	175.8	23.5 to 23.7	55.1 to 56.0
Lower	177.1	19.5 to 19.6	53.3 to 54.0

Area S of test specimen:	17.85 m^2
Mass per unit area:	189 kg/m^2

f (Hz)	Airborne TL (dB)
50	33
63	37
80	37
100	35
125	36
160	37
200	37
250	38
315	39
400	38
500	42
630	47
800	51
1000	56
1250	61
1600	67
2000	74
2500	82
3150	85
4000	86
5000	84
Sound Transmission Class (STC)	**47**

Sum of Deficiencies (dB)
20
Max. Deficiency (dB)
8 dB at 400 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Airborne sound transmission loss measurements were conducted in accordance with the requirements of ASTM E90-09, "Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements".**

In the graph:
The solid line is the measured sound transmission loss for this specimen. The dashed line is the STC contour fitted to the measured values according to ASTM E413-10. The dotted line (may be above the displayed range) is 10 dB below the flanking limit established for this facility. For any frequency band where the measured transmission loss is above the dotted line, the reported value is potentially limited by flanking transmission via laboratory surfaces, and the true value may be higher than that measured. Bars at the bottom of the graph show deficiencies where the measured data are less than the reference contour as described in the fitting procedure for the STC, defined in ASTM E413-10. The shaded cells in the table and areas in the graph are outside the STC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. The reported values have been corrected according to the procedure outlined in ASTM E90-09. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level, in which case, the corrected values provide an estimate of the lower limit of airborne sound transmission loss.

ASTM E492 Test Results – Normalized Impact Sound Pressure Levels

Client: Nordic Engineered Wood **Test ID:** IIF-15-035

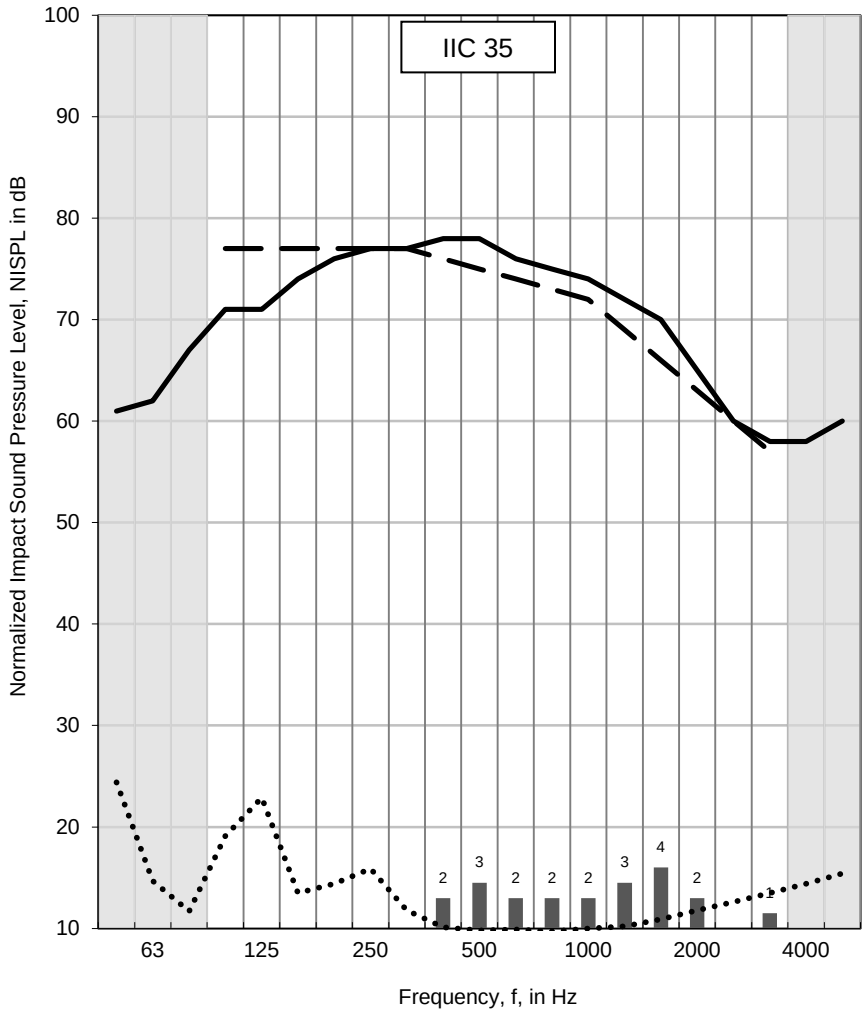
Specimen ID: A1-006070-28F **Date of Test:** May 27, 2015

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Upper	175.8	23.1 to 23.3	57.6 to 58.8
Lower	177.1	19.4 to 19.4	53.7 to 54.6

Area S of test specimen:	17.85 m^2
Mass per unit area:	189 kg/m^2

f (Hz)	NISPL (dB)
50	61
63	62
80	67
100	71
125	71
160	74
200	76
250	77
315	77
400	78
500	78
630	76
800	75
1000	74
1250	72
1600	70
2000	65
2500	60
3150	58
4000	58
5000	60
Impact Insulation Class (IIC)	**35**

Sum of Positive Differences (dB)
21
Max. Positive Difference (dB)
4 dB at 1600 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Measurements of normalized impact sound pressure level (NISPL) were conducted in accordance with the requirements of ASTM E492-09, "Standard Laboratory Measurement of Impact Sound Transmission through Floor-Ceiling Assemblies Using the Tapping Machine".**

In the graph:
The solid line is the measured normalized impact sound pressure level (NISPL) for this specimen. The dashed line is the IIC contour fitted to the measured values according to ASTM E989-06. The dotted line is the background sound level measured in the receiving room during this test (may be below the displayed range). For any frequency where measured NISPL is less than 10 dB above the dotted line, the reported values were adjusted as noted below. Bars at bottom of graph show positive differences; where the measured data are greater than the reference contour as defined in ASTM E989-06. Shaded cells in the table and areas in the graph are outside the IIC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level and the reported values of NISPL provide an estimate of the upper limit of normalized impact sound pressure level, according to the procedure outlined in ASTM E492-09. The reported values of NISPL have been corrected according to the procedure outlined in ASTM E492-09.

Client Nordic Engineered Wood
1100 Ave des Canadiens-de-Montreal
Montreal QC H3B 2S2

Specimen 7 mm laminate floating floor on 3 mm premium felt placed on 50 mm (2") normal strength concrete poured on 10 mm tar boards placed on top of a CLT 5 ply (131 mm).

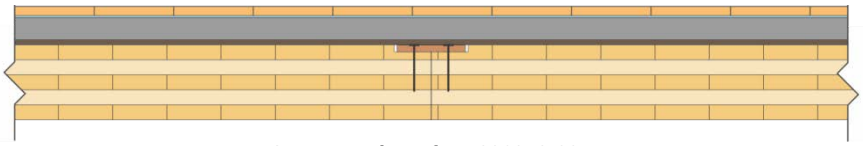
Specimen ID A1-006070-29F

Construction Date: May 28, 2015 to May 29, 2015

Specimen Description

The specimen was composed of two cross-laminated timber (CLT) 5 ply (131 mm thick x 1989 mm wide x 4872 mm long) panels with a butt joint in the middle of the floor. The combined panels filled the entire floor opening of the test frame. The two CLT panels were joined using a 120 mm wide x 12 mm thick plywood strip spanning the full joint (4.9 m). The plywood strip was nailed with common nails 75 mm (3") long spaced 305 mm (12") on centre along the joint with beads of PL premium adhesive between the plywood strip and the CLT panels. The CLT floor was resting on the lip of the test frame and was not fastened to the test frame. The air gaps between the edges of the CLT floor and the test frame were filled with glass fiber insulation and covered with cloth tape. Duct putty was installed around the lower perimeter of the test frame and the CLT.

Laminate floating floor (7 mm thick) was installed on top of a 3 mm Acoustic-Tech™ Premium Felt Membrane which was placed on top of a 50 mm (2") normal strength concrete which was poured on a 0.1 mm (4 mils) polyethylene sheeting top of 10 mm tar boards which were placed on the CLT floor.



Cross-section of A1-006070-29F

Specimen Properties

Element	Actual thickness (mm)	Mass (kg)	Mass/length, area or volume
7 mm Generic Laminate Floating Floor	7	115	5.8 kg/m^2
3 mm Acoustic-Tech™ Premium Felt Membrane	3	9.5	0.5 kg/m^2
50 mm Poured Concrete	50	2376	119.0 kg/m^2
10 mm Tar Board (Building Products)	10	56	2.8 kg/m^2
131 mm CLT 5-ply	131	1338	67.0 kg/m^2
Total	**201**	**3895**	**195 kg/m^2**

Test Specimen Installation

- The exposed area of the floor specimen used for the calculations of the airborne sound transmission loss was 17.85 m^2 (4.71 m x 3.79 m).
- The total area of the floor assembly resting on top of the lip was 19.32 m^2 (4.88 m x 3.96 m).
- The mass per area of the elements above the lip was calculated using the total area (19.32 m^2).

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ASTM E90 Test Results – Airborne Sound Transmission Loss

Client: Nordic Engineered Wood **Test ID:** TLF-15-041

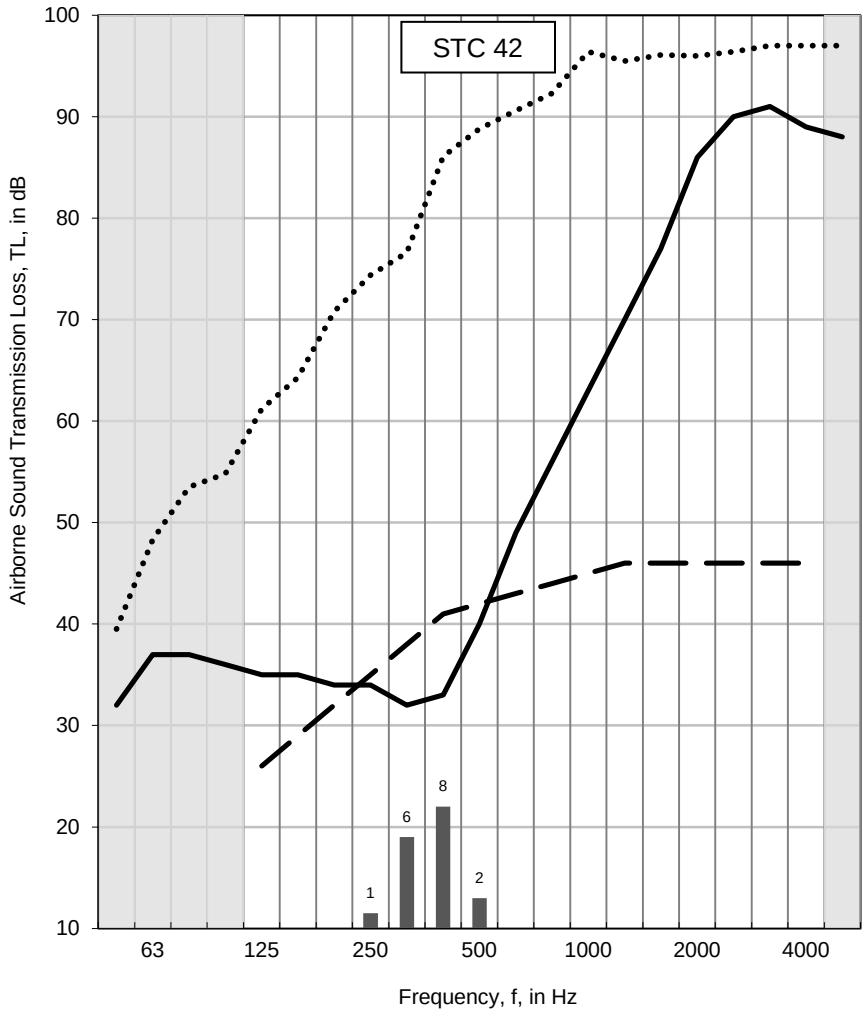
Specimen ID: A1-006070-29F **Date of Test:** June 1, 2015

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Upper	175.5	23.1 to 23.1	39.1 to 39.1
Lower	177.1	19.8 to 19.9	48.8 to 48.9

Area S of test specimen:	17.85 m^2
Mass per unit area:	195 kg/m^2

f (Hz)	Airborne TL (dB)	
50	32	
63	37	
80	37	
100	36	
125	35	
160	35	
200	34	
250	34	
315	32	
400	33	
500	40	
630	49	
800	56	
1000	63	
1250	70	
1600	77	c
2000	86	c
2500	90	*
3150	91	*
4000	89	c
5000	88	c
Sound Transmission Class (STC)	**42**	

Sum of Deficiencies (dB)
17
Max. Deficiency (dB)
8 dB at 400 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Airborne sound transmission loss measurements were conducted in accordance with the requirements of ASTM E90-09, "Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements".**

In the graph:
The solid line is the measured sound transmission loss for this specimen. The dashed line is the STC contour fitted to the measured values according to ASTM E413-10. The dotted line (may be above the displayed range) is 10 dB below the flanking limit established for this facility. For any frequency band where the measured transmission loss is above the dotted line, the reported value is potentially limited by flanking transmission via laboratory surfaces, and the true value may be higher than that measured. Bars at the bottom of the graph show deficiencies where the measured data are less than the reference contour as described in the fitting procedure for the STC, defined in ASTM E413-10. The shaded cells in the table and areas in the graph are outside the STC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. The reported values have been corrected according to the procedure outlined in ASTM E90-09. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level, in which case, the corrected values provide an estimate of the lower limit of airborne sound transmission loss.

ASTM E492 Test Results – Normalized Impact Sound Pressure Levels

Client: Nordic Engineered Wood **Test ID:** IIF-15-036

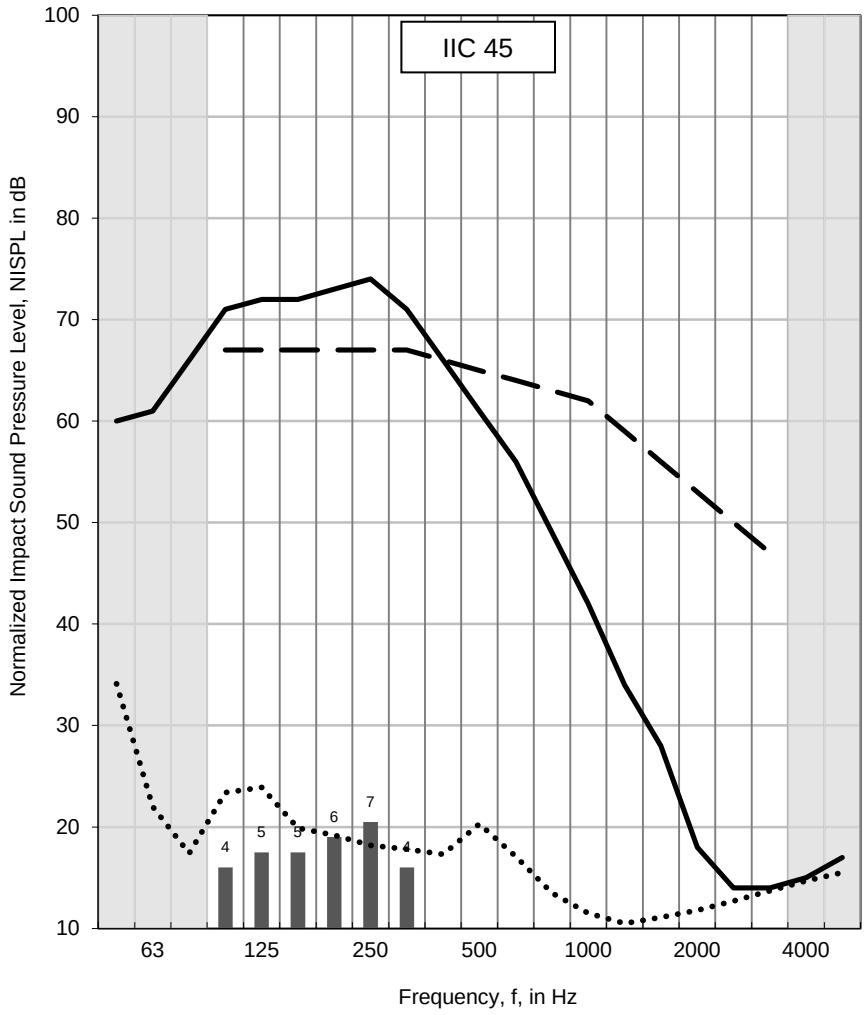
Specimen ID: A1-006070-29F **Date of Test:** May 9, 2015

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Upper	175.5	23.8 to 23.9	42.8 to 43.1
Lower	177.1	19.9 to 19.9	49.8 to 49.9

Area S of test specimen:	17.85 m^2
Mass per unit area:	195 kg/m^2

f (Hz)	NISPL (dB)	
50	60	
63	61	
80	66	
100	71	
125	72	
160	72	
200	73	
250	74	
315	71	
400	66	
500	61	
630	56	
800	49	
1000	42	
1250	34	
1600	28	
2000	18	*
2500	14	*
3150	14	*
4000	15	*
5000	17	*
Impact Insulation Class (IIC)	**45**	

Sum of Positive Differences (dB)
31
Max. Positive Difference (dB)
7 dB at 250 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Measurements of normalized impact sound pressure level (NISPL) were conducted in accordance with the requirements of ASTM E492-09, "Standard Laboratory Measurement of Impact Sound Transmission through Floor-Ceiling Assemblies Using the Tapping Machine".**

In the graph:
The solid line is the measured normalized impact sound pressure level (NISPL) for this specimen. The dashed line is the IIC contour fitted to the measured values according to ASTM E989-06. The dotted line is the background sound level measured in the receiving room during this test (may be below the displayed range). For any frequency where measured NISPL is less than 10 dB above the dotted line, the reported values were adjusted as noted below. Bars at bottom of graph show positive differences; where the measured data are greater than the reference contour as defined in ASTM E989-06. Shaded cells in the table and areas in the graph are outside the IIC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level and the reported values of NISPL provide an estimate of the upper limit of normalized impact sound pressure level, according to the procedure outlined in ASTM E492-09. The reported values of NISPL have been corrected according to the procedure outlined in ASTM E492-09.

Client Nordic Engineered Wood
1100 Ave des Canadiens-de-Montreal
Montreal QC H3B 2S2

Specimen 70 mm cement mortar precast slab on 13 mm (1/2") rubber membrane on 10 mm tar boards placed on top of a CLT 5 ply (175 mm).

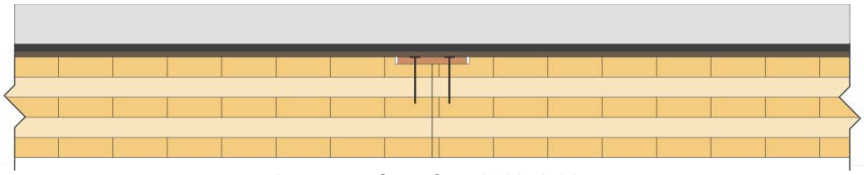
Specimen ID A1-006070-30F

Construction Date: June 2, 2015 to June 3, 2015

Specimen Description

The specimen was composed of two cross-laminated timber (CLT) 5 ply (175 mm thick x 1989 mm wide x 4872 mm long) panels with a butt joint in the middle of the floor. The combined panels filled the entire floor opening of the test frame. The two CLT panels were joined using a 120 mm wide x 12 mm thick plywood strip spanning the full joint (4.9 m). The plywood strip was nailed with common nails 75 mm (3") long spaced 305 mm (12") on centre along the joint with beads of PL premium adhesive between the plywood strip and the CLT panels. The CLT floor was resting on the lip of the test frame and was not fastened to the test frame. The air gaps between the edges of the CLT floor and the test frame were filled with glass fiber insulation and covered with cloth tape. Duct putty was installed around the lower perimeter of the test frame and the CLT.

A 70 mm cement mortar precast slab was placed on a 13 mm (1/2") INSONOMAT rubber membrane on top of 10 mm tar boards which were placed on the CLT floor.



Cross-section of A1-006070-30F

Specimen Properties

Element	Actual thickness (mm)	Mass (kg)	Mass/length, area or volume
70 mm Cement Mortar Precast Slab	70	3243	162.0 kg/m^2
13 mm INSONOMAT Rubber Membrane	13	90	4.5 kg/m^2
10 mm Tar Board (Building Products)	10	56	2.8 kg/m^2
175 mm CLT 5-ply	175	1760	91.0 kg/m^2
Total	**268**	**5149**	**260 kg/m^2**

Test Specimen Installation

- The exposed area of the floor specimen used for the calculations of the airborne sound transmission loss was 17.85 m^2 (4.71 m x 3.79 m).
- The total area of the floor assembly resting on top of the lip was 19.32 m^2 (4.88 m x 3.96 m).
- The mass per area of the elements above the lip was calculated using the total area (19.32 m^2).

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ASTM E90 Test Results – Airborne Sound Transmission Loss

Client: Nordic Engineered Wood **Test ID:** TLF-15-042

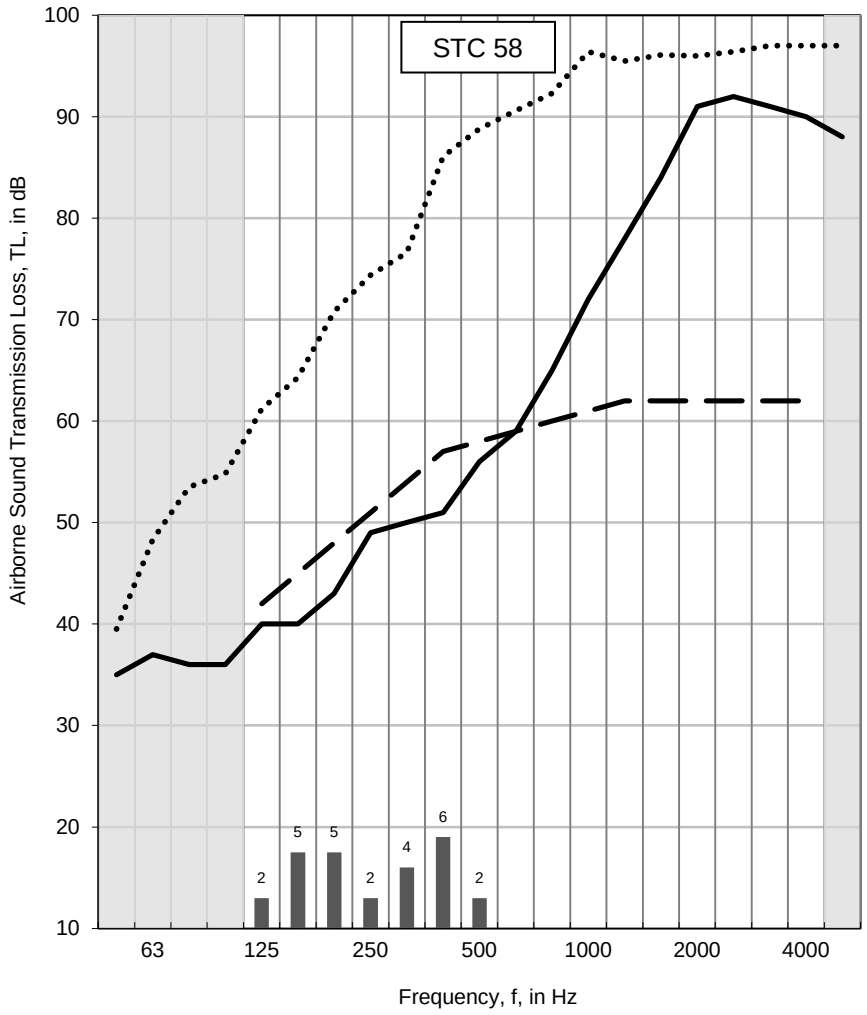
Specimen ID: A1-006070-30F **Date of Test:** June 3, 2015

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Upper	174.4	22.0 to 22.1	37.8 to 37.9
Lower	176.8	18.4 to 18.4	47.1 to 47.2

Area S of test specimen:	17.85 m^2
Mass per unit area:	260 kg/m^2

f (Hz)	Airborne TL (dB)	
50	35	
63	37	
80	36	
100	36	
125	40	
160	40	
200	43	
250	49	
315	50	
400	51	
500	56	
630	59	
800	65	
1000	72	c
1250	78	*
1600	84	*
2000	91	*
2500	92	*
3150	91	c
4000	90	c
5000	88	c
Sound Transmission Class (STC)	**58**	

Sum of Deficiencies (dB)
26
Max. Deficiency (dB)
6 dB at 400 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Airborne sound transmission loss measurements were conducted in accordance with the requirements of ASTM E90-09, "Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements".**

In the graph:
The solid line is the measured sound transmission loss for this specimen. The dashed line is the STC contour fitted to the measured values according to ASTM E413-10. The dotted line (may be above the displayed range) is 10 dB below the flanking limit established for this facility. For any frequency band where the measured transmission loss is above the dotted line, the reported value is potentially limited by flanking transmission via laboratory surfaces, and the true value may be higher than that measured. Bars at the bottom of the graph show deficiencies where the measured data are less than the reference contour as described in the fitting procedure for the STC, defined in ASTM E413-10. The shaded cells in the table and areas in the graph are outside the STC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. The reported values have been corrected according to the procedure outlined in ASTM E90-09. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level, in which case, the corrected values provide an estimate of the lower limit of airborne sound transmission loss.

ASTM E492 Test Results – Normalized Impact Sound Pressure Levels

Client: Nordic Engineered Wood **Test ID:** IIF-15-037

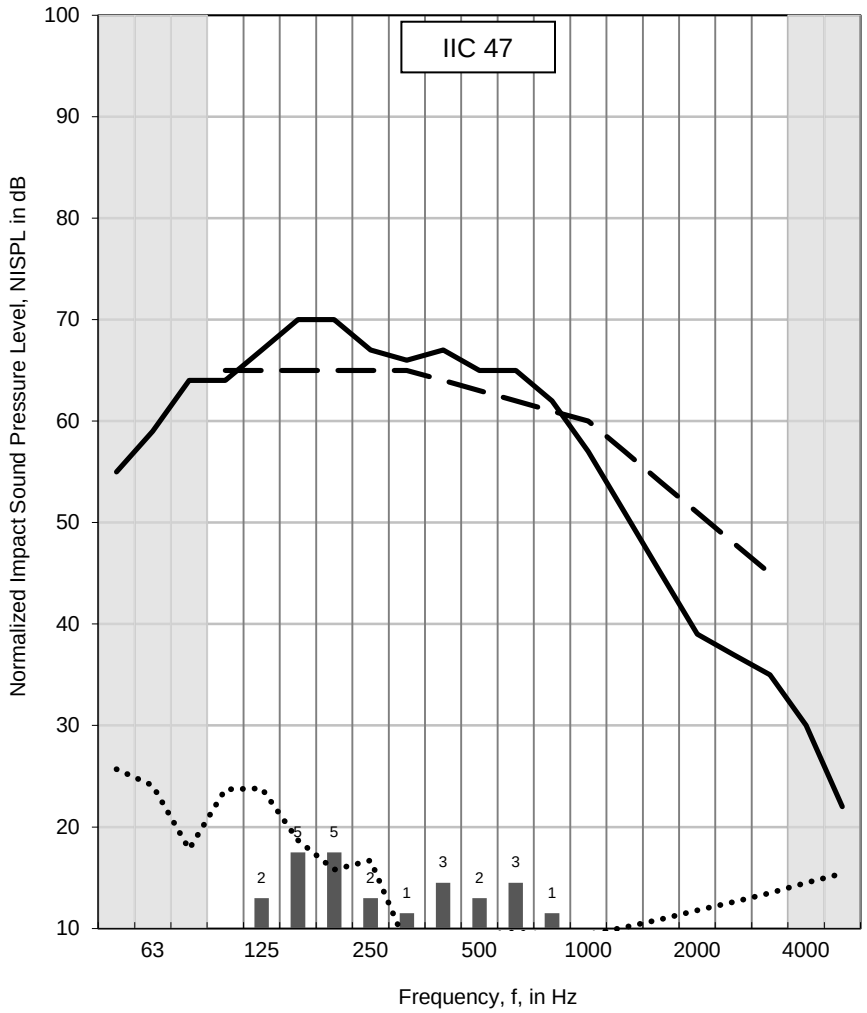
Specimen ID: A1-006070-30F **Date of Test:** June 3, 2015

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Upper	174.4	21.7 to 21.9	38.1 to 38.5
Lower	176.8	18.5 to 18.5	46.4 to 46.8

Area S of test specimen:	17.85 m^2
Mass per unit area:	260 kg/m^2

f (Hz)	NISPL (dB)	
50	55	
63	59	
80	64	
100	64	
125	67	
160	70	
200	70	
250	67	
315	66	
400	67	
500	65	
630	65	
800	62	
1000	57	
1250	51	
1600	45	
2000	39	
2500	37	
3150	35	
4000	30	c
5000	22	*
Impact Insulation Class (IIC)	**47**	

Sum of Positive Differences (dB)
24
Max. Positive Difference (dB)
5 dB at 160 and 200 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Measurements of normalized impact sound pressure level (NISPL) were conducted in accordance with the requirements of ASTM E492-09, "Standard Laboratory Measurement of Impact Sound Transmission through Floor-Ceiling Assemblies Using the Tapping Machine".**

In the graph:
The solid line is the measured normalized impact sound pressure level (NISPL) for this specimen. The dashed line is the IIC contour fitted to the measured values according to ASTM E989-06. The dotted line is the background sound level measured in the receiving room during this test (may be below the displayed range). For any frequency where measured NISPL is less than 10 dB above the dotted line, the reported values were adjusted as noted below. Bars at bottom of graph show positive differences; where the measured data are greater than the reference contour as defined in ASTM E989-06. Shaded cells in the table and areas in the graph are outside the IIC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level and the reported values of NISPL provide an estimate of the upper limit of normalized impact sound pressure level, according to the procedure outlined in ASTM E492-09. The reported values of NISPL have been corrected according to the procedure outlined in ASTM E492-09.

Client Nordic Engineered Wood
1100 Ave des Canadiens-de-Montreal
Montreal QC H3B 2S2

Specimen 70 mm cement mortar precast slab on 13 mm (1/2") rubber membrane placed on top of a CLT 5 ply (175 mm).

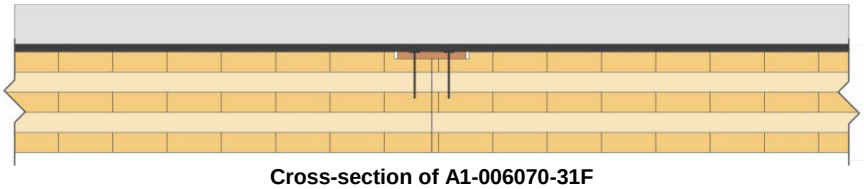
Specimen ID A1-006070-31F

Construction Date: June 4, 2015

Specimen Description

The specimen was composed of two cross-laminated timber (CLT) 5 ply (175 mm thick x 1989 mm wide x 4872 mm long) panels with a butt joint in the middle of the floor. The combined panels filled the entire floor opening of the test frame. The two CLT panels were joined using a 120 mm wide x 12 mm thick plywood strip spanning the full joint (4.9 m). The plywood strip was nailed with common nails 75 mm (3") long spaced 305 mm (12") on centre along the joint with beads of PL premium adhesive between the plywood strip and the CLT panels. The CLT floor was resting on the lip of the test frame and was not fastened to the test frame. The air gaps between the edges of the CLT floor and the test frame were filled with glass fiber insulation and covered with cloth tape. Duct putty was installed around the lower perimeter of the test frame and the CLT.

A 70 mm cement mortar precast slab was placed on a 13 mm (1/2") INSONOMAT rubber membrane which were placed on the CLT floor.



Cross-section of A1-006070-31F

Specimen Properties

Element	Actual thickness (mm)	Mass (kg)	Mass/length, area or volume
70 mm Cement Mortar Precast Slab	70	3243	162.0 kg/m^2
13 mm INSONOMAT Rubber Membrane	13	90	4.5 kg/m^2
175 mm CLT 5-ply	175	1760	91.0 kg/m^2
Total	**258**	**5093**	**258 kg/m^2**

Test Specimen Installation

- The exposed area of the floor specimen used for the calculations of the airborne sound transmission loss was 17.85 m^2 (4.71 m x 3.79 m).
- The total area of the floor assembly resting on top of the lip was 19.32 m^2 (4.88 m x 3.96 m).
- The mass per area of the elements above the lip was calculated using the total area (19.32 m^2).

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ASTM E90 Test Results – Airborne Sound Transmission Loss

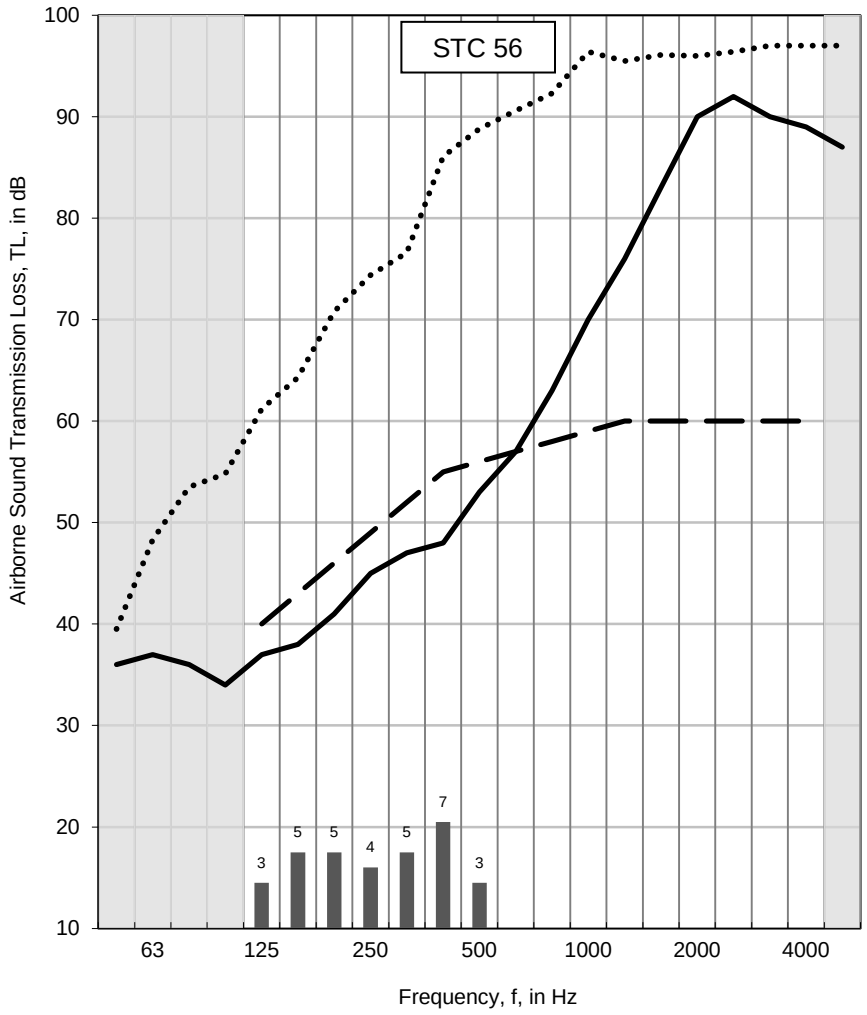
Client: Nordic Engineered Wood **Test ID:** TLF-15-044

Specimen ID: A1-006070-31F **Date of Test:** June 5, 2015

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Upper	174.1	23.9 to 24.2	38.5 to 38.9
Lower	176.9	19.6 to 19.6	48.7 to 48.8

Area S of test specimen:	17.85 m^2
Mass per unit area:	258 kg/m^2

f (Hz)	Airborne TL (dB)	
50	36	
63	37	
80	36	
100	34	
125	37	
160	38	
200	41	
250	45	
315	47	
400	48	
500	53	
630	57	
800	63	
1000	70	
1250	76	
1600	83	
2000	90	c
2500	92	*
3150	90	c
4000	89	c
5000	87	
Sound Transmission Class (STC)	**56**	



Sum of Deficiencies (dB)
32
Max. Deficiency (dB)
7 dB at 400 Hz

For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Airborne sound transmission loss measurements were conducted in accordance with the requirements of ASTM E90-09, "Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements".**

In the graph:
The solid line is the measured sound transmission loss for this specimen. The dashed line is the STC contour fitted to the measured values according to ASTM E413-10. The dotted line (may be above the displayed range) is 10 dB below the flanking limit established for this facility. For any frequency band where the measured transmission loss is above the dotted line, the reported value is potentially limited by flanking transmission via laboratory surfaces, and the true value may be higher than that measured. Bars at the bottom of the graph show deficiencies where the measured data are less than the reference contour as described in the fitting procedure for the STC, defined in ASTM E413-10. The shaded cells in the table and areas in the graph are outside the STC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. The reported values have been corrected according to the procedure outlined in ASTM E90-09. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level, in which case, the corrected values provide an estimate of the lower limit of airborne sound transmission loss.

ASTM E492 Test Results – Normalized Impact Sound Pressure Levels

Client: Nordic Engineered Wood **Test ID:** IIF-15-038

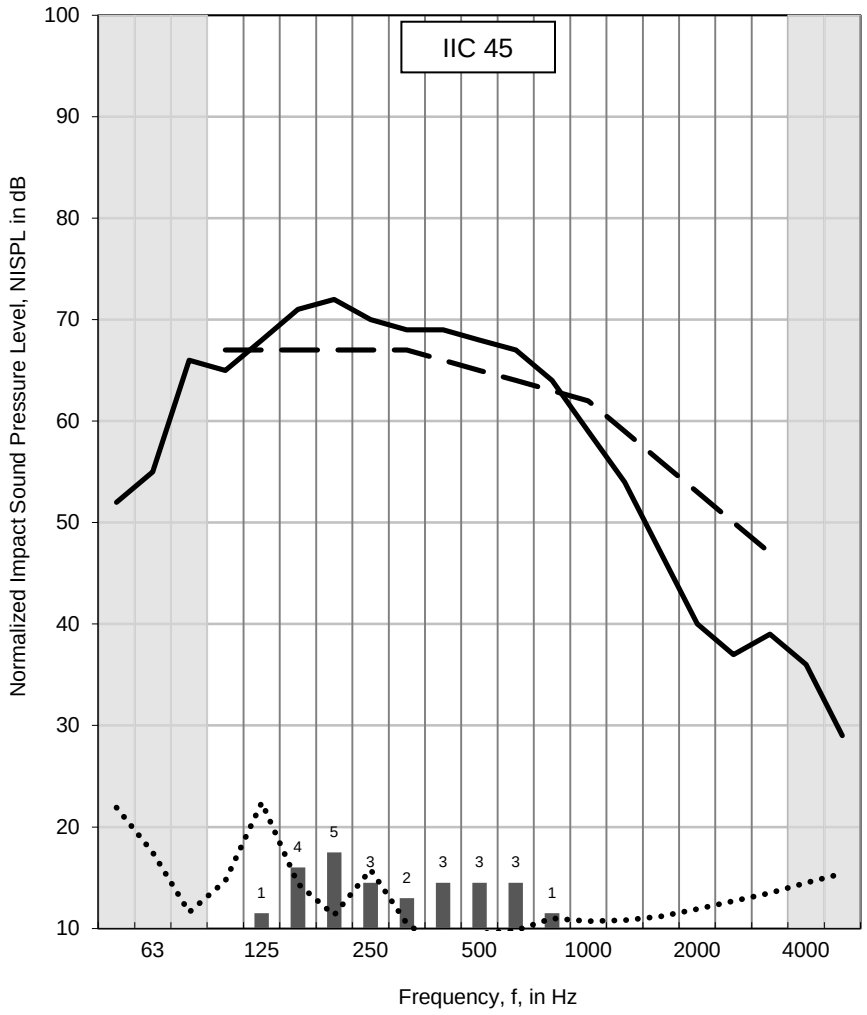
Specimen ID: A1-006070-31F **Date of Test:** June 4, 2015

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Upper	174.1	23.0 to 22.8	38.1 to 38.8
Lower	176.9	18.7 to 18.8	50.4 to 51.6

Area S of test specimen:	17.85 m^2
Mass per unit area:	258 kg/m^2

f (Hz)	NISPL (dB)	
50	52	
63	55	
80	66	
100	65	
125	68	
160	71	
200	72	
250	70	
315	69	
400	69	
500	68	
630	67	
800	64	
1000	59	
1250	54	
1600	47	
2000	40	
2500	37	
3150	39	
4000	36	
5000	29	c
Impact Insulation Class (IIC)	**45**	

Sum of Positive Differences (dB)
25
Max. Positive Difference (dB)
5 dB at 200 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Measurements of normalized impact sound pressure level (NISPL) were conducted in accordance with the requirements of ASTM E492-09, "Standard Laboratory Measurement of Impact Sound Transmission through Floor-Ceiling Assemblies Using the Tapping Machine".**

In the graph:
The solid line is the measured normalized impact sound pressure level (NISPL) for this specimen. The dashed line is the IIC contour fitted to the measured values according to ASTM E989-06. The dotted line is the background sound level measured in the receiving room during this test (may be below the displayed range). For any frequency where measured NISPL is less than 10 dB above the dotted line, the reported values were adjusted as noted below. Bars at bottom of graph show positive differences; where the measured data are greater than the reference contour as defined in ASTM E989-06. Shaded cells in the table and areas in the graph are outside the IIC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level and the reported values of NISPL provide an estimate of the upper limit of normalized impact sound pressure level, according to the procedure outlined in ASTM E492-09. The reported values of NISPL have been corrected according to the procedure outlined in ASTM E492-09.

Client Nordic Engineered Wood
1100 Ave des Canadiens-de-Montreal
Montreal QC H3B 2S2

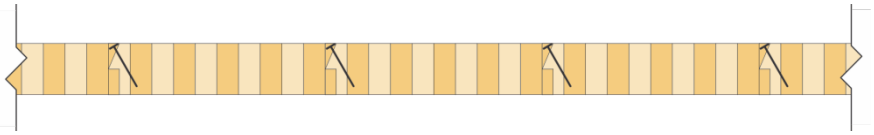
Specimen Bare 89 mm (3-1/2") glulam decking floor

Specimen ID A1-006070-32F

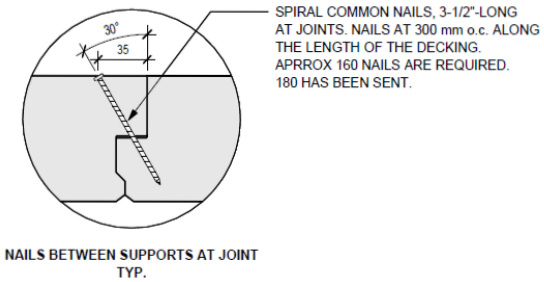
Construction Date: June 15, 2015 to June 17, 2015

Specimen Description

The specimen was composed of glued-laminated timber (glulam) decking panels ranging from 270 mm to 384 mm wide x 89 mm thick x 3890 mm long. The combined panels filled the entire floor opening of the test frame. The glulam decking were joined using 90 mm (3-1/2") long common nails spaced 300 mm (12") on centre along the joints. The glulam decking floor was resting on the lip of the test frame and was not fastened to the test frame. The air gaps between the edges of the glulam decking floor and the test frame were filled with glass fiber insulation and covered with cloth tape. Duct putty was installed around the lower perimeter of the test frame and the glulam.



Cross-section of A1-006070-32F



Fastening details of glulam decking

Specimen Properties

Element	Actual thickness (mm)	Mass (kg)	Mass/length, area or volume
89 mm Glulam Decking	89	912	45.6 kg/m^2
Total	**89**	**912**	**46 kg/m^2**

Test Specimen Installation

- The exposed area of the floor specimen used for the calculations of the airborne sound transmission loss was 17.85 m^2 (4.71 m x 3.79 m).
- The total area of the floor assembly resting on top of the lip was 19.32 m^2 (4.88 m x 3.96 m).
- The mass per area of the elements above the lip was calculated using the total area (19.32 m^2).

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ASTM E90 Test Results – Airborne Sound Transmission Loss

Client: Nordic Engineered Wood **Test ID:** TLF-15-046

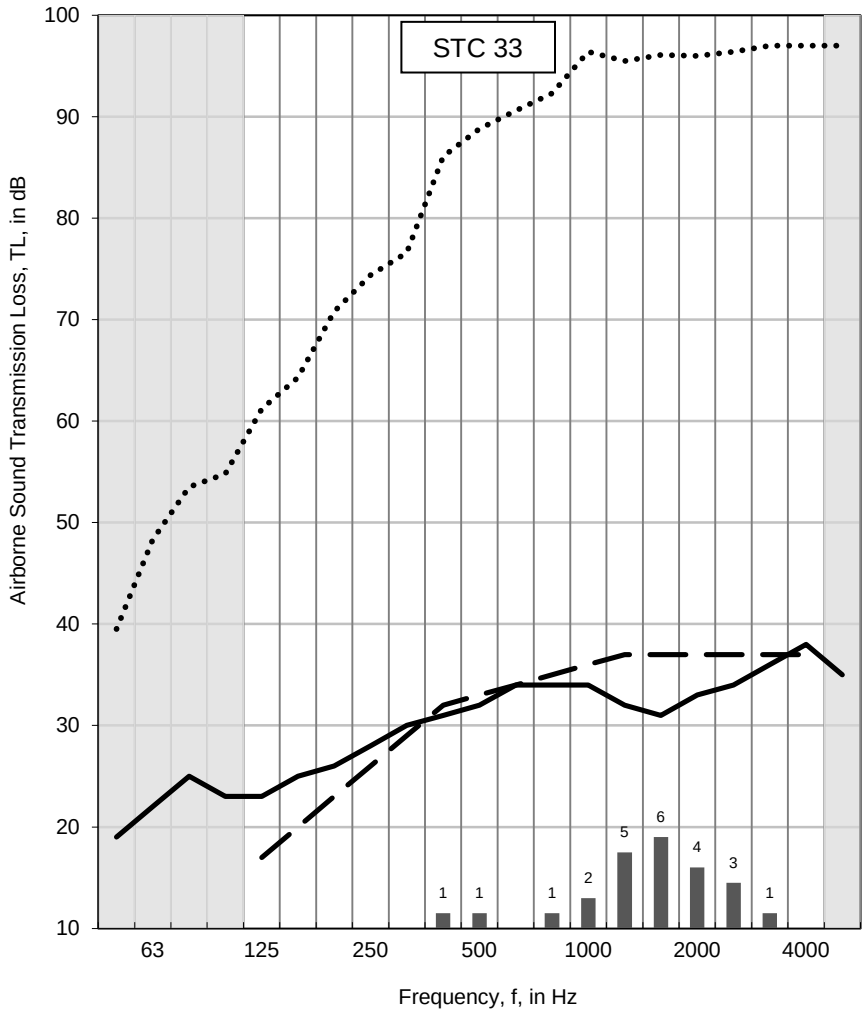
Specimen ID: A1-006070-32F **Date of Test:** June 17, 2015

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Upper	177.7	24.3 to 24.4	50.0 to 50.1
Lower	176.9	20.5 to 20.5	51.1 to 51.6

Area S of test specimen:	17.85 m^2
Mass per unit area:	46 kg/m^2

f (Hz)	Airborne TL (dB)
50	19
63	22
80	25
100	23
125	23
160	25
200	26
250	28
315	30
400	31
500	32
630	34
800	34
1000	34
1250	32
1600	31
2000	33
2500	34
3150	36
4000	38
5000	35
Sound Transmission Class (STC)	**33**

Sum of Deficiencies (dB)
24
Max. Deficiency (dB)
6 dB at 1600 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Airborne sound transmission loss measurements were conducted in accordance with the requirements of ASTM E90-09, "Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements".**

In the graph:
The solid line is the measured sound transmission loss for this specimen. The dashed line is the STC contour fitted to the measured values according to ASTM E413-10. The dotted line (may be above the displayed range) is 10 dB below the flanking limit established for this facility. For any frequency band where the measured transmission loss is above the dotted line, the reported value is potentially limited by flanking transmission via laboratory surfaces, and the true value may be higher than that measured. Bars at the bottom of the graph show deficiencies where the measured data are less than the reference contour as described in the fitting procedure for the STC, defined in ASTM E413-10. The shaded cells in the table and areas in the graph are outside the STC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. The reported values have been corrected according to the procedure outlined in ASTM E90-09. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level, in which case, the corrected values provide an estimate of the lower limit of airborne sound transmission loss.

ASTM E492 Test Results – Normalized Impact Sound Pressure Levels

Client: Nordic Engineered Wood **Test ID:** IIF-15-040

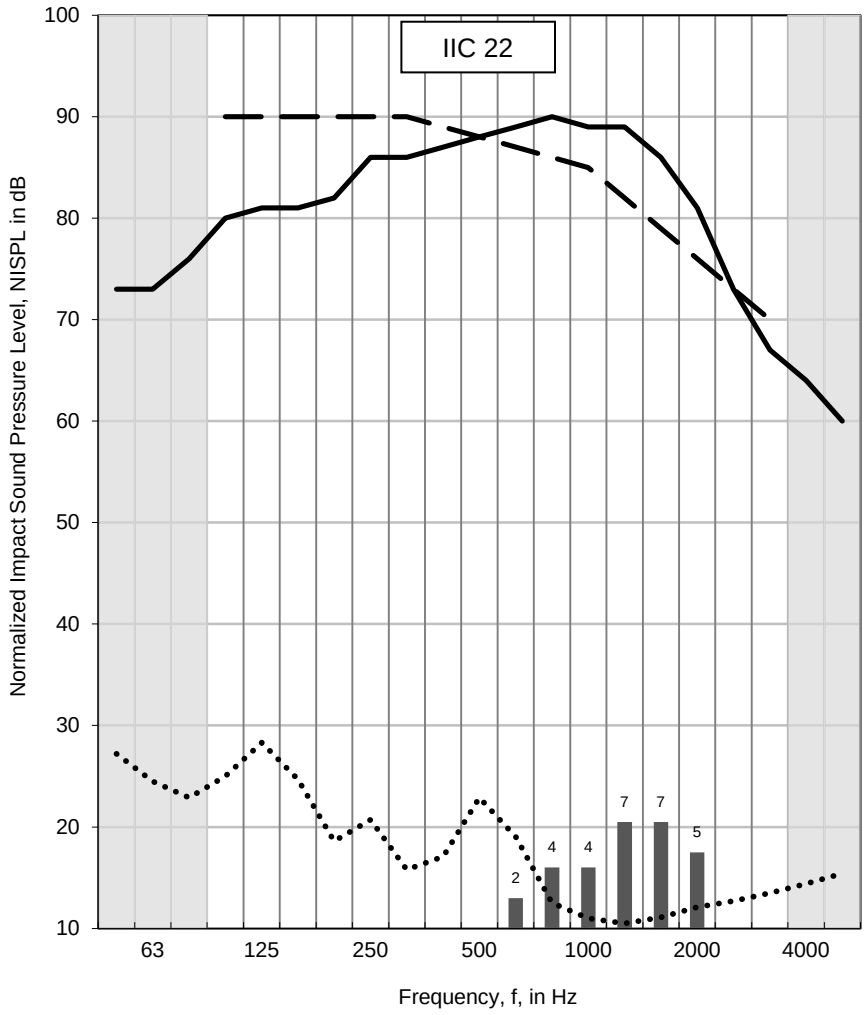
Specimen ID: A1-006070-32F **Date of Test:** June 17, 2015

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Upper	177.7	24.1 to 24.2	50.2 to 50.4
Lower	176.9	20.6 to 20.6	48.8 to 50.0

Area S of test specimen:	17.85 m^2
Mass per unit area:	46 kg/m^2

f (Hz)	NISPL (dB)
50	73
63	73
80	76
100	80
125	81
160	81
200	82
250	86
315	86
400	87
500	88
630	89
800	90
1000	89
1250	89
1600	86
2000	81
2500	73
3150	67
4000	64
5000	60
Impact Insulation Class (IIC)	**22**

Sum of Positive Differences (dB)
29
Max. Positive Difference (dB)
7 dB at 1250 and 1600 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Measurements of normalized impact sound pressure level (NISPL) were conducted in accordance with the requirements of ASTM E492-09, "Standard Laboratory Measurement of Impact Sound Transmission through Floor-Ceiling Assemblies Using the Tapping Machine".**

In the graph:
The solid line is the measured normalized impact sound pressure level (NISPL) for this specimen. The dashed line is the IIC contour fitted to the measured values according to ASTM E989-06. The dotted line is the background sound level measured in the receiving room during this test (may be below the displayed range). For any frequency where measured NISPL is less than 10 dB above the dotted line, the reported values were adjusted as noted below. Bars at bottom of graph show positive differences; where the measured data are greater than the reference contour as defined in ASTM E989-06. Shaded cells in the table and areas in the graph are outside the IIC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level and the reported values of NISPL provide an estimate of the upper limit of normalized impact sound pressure level, according to the procedure outlined in ASTM E492-09. The reported values of NISPL have been corrected according to the procedure outlined in ASTM E492-09.

Client Nordic Engineered Wood
1100 Ave des Canadiens-de-Montreal
Montreal QC H3B 2S2

Specimen 70 mm cement mortar precast slab on 13 mm (1/2") rubber membrane placed on top of a 89 mm (3-1/2") glulam decking floor

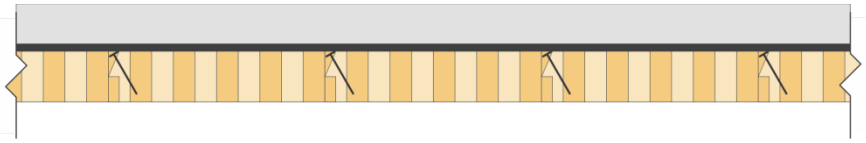
Specimen ID A1-006070-33F

Construction Date: June 19, 2015

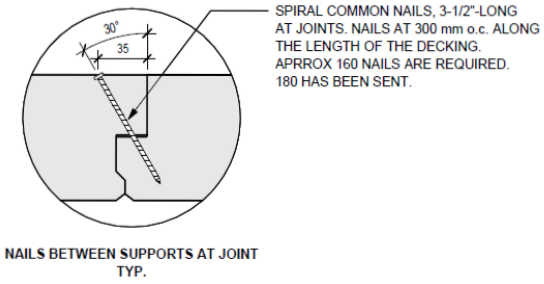
Specimen Description

The specimen was composed of glued-laminated timber (glulam) decking panels ranging from 270 mm to 384 mm wide x 89 mm thick x 3890 mm long. The combined panels filled the entire floor opening of the test frame. The glulam decking were joined using 90 mm (3-1/2") long common nails spaced 300 mm (12") on centre along the joints. The glulam decking floor was resting on the lip of the test frame and was not fastened to the test frame. The air gaps between the edges of the glulam decking floor and the test frame were filled with glass fiber insulation and covered with cloth tape. Duct putty was installed around the lower perimeter of the test frame and the glulam.

A 70 mm cement mortar precast slab was placed on a 13 mm (1/2") INSONOMAT rubber membrane which was placed on the glulam decking floor.



Cross-section of A1-006070-33F



Fastening details of glulam decking

Specimen Properties

Element	Actual thickness (mm)	Mass (kg)	Mass/length, area or volume
70 mm Cement Mortar Precast Slab	70	3243	162.0 kg/m^2
13 mm INSONOMAT Rubber Membrane	13	90	4.5 kg/m^2
89 mm Glulam Decking	89	912	45.6 kg/m^2
Total	**172**	**4245**	**212 kg/m^2**

Test Specimen Installation

- The exposed area of the floor specimen used for the calculations of the airborne sound transmission loss was 17.85 m^2 (4.71 m x 3.79 m).
- The total area of the floor assembly resting on top of the lip was 19.32 m^2 (4.88 m x 3.96 m).
- The mass per area of the elements above the lip was calculated using the total area (19.32 m^2).

ASTM E90 Test Results – Airborne Sound Transmission Loss

Client: Nordic Engineered Wood **Test ID:** TLF-15-048

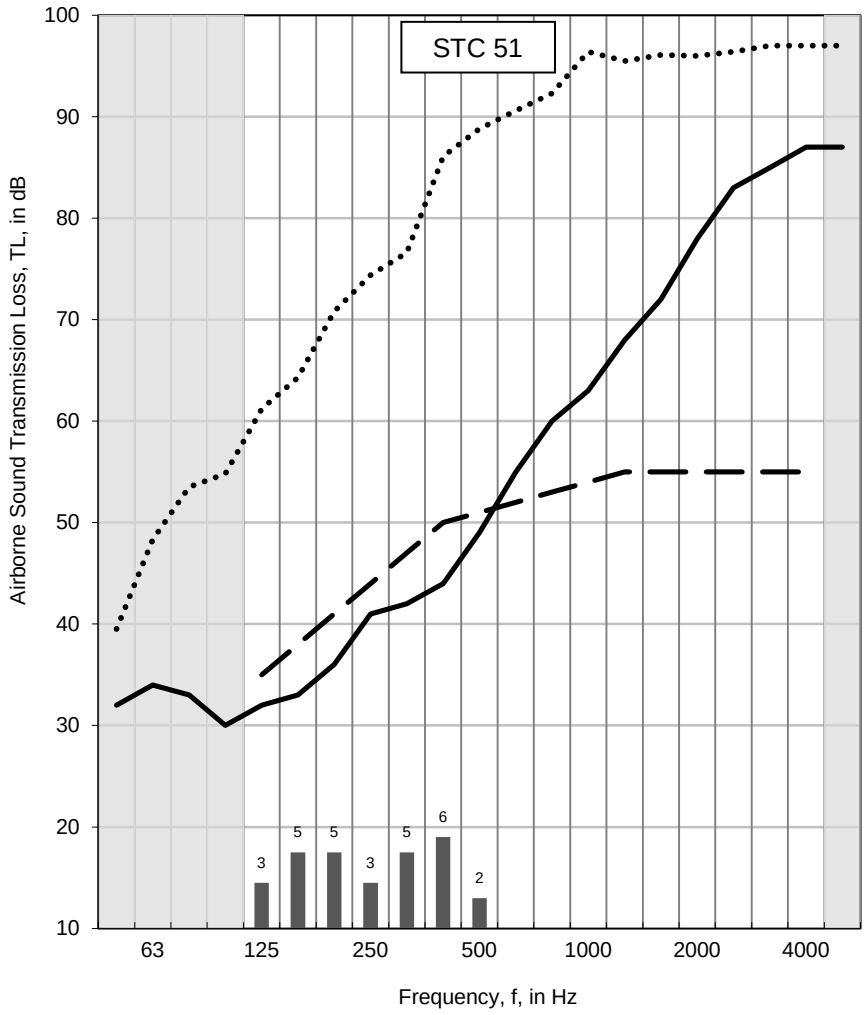
Specimen ID: A1-006070-33F **Date of Test:** June 19, 2015

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Upper	176.1	24.0 to 24.1	47.5 to 50.5
Lower	176.9	20.6 to 20.8	49.5 to 50.6

Area S of test specimen:	17.85 m^2
Mass per unit area:	212 kg/m^2

f (Hz)	Airborne TL (dB)
50	32
63	34
80	33
100	30
125	32
160	33
200	36
250	41
315	42
400	44
500	49
630	55
800	60
1000	63
1250	68
1600	72
2000	78
2500	83
3150	85
4000	87
5000	87
Sound Transmission Class (STC)	**51**

Sum of Deficiencies (dB)
29
Max. Deficiency (dB)
6 dB at 400 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Airborne sound transmission loss measurements were conducted in accordance with the requirements of ASTM E90-09, "Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements".**

In the graph:
The solid line is the measured sound transmission loss for this specimen. The dashed line is the STC contour fitted to the measured values according to ASTM E413-10. The dotted line (may be above the displayed range) is 10 dB below the flanking limit established for this facility. For any frequency band where the measured transmission loss is above the dotted line, the reported value is potentially limited by flanking transmission via laboratory surfaces, and the true value may be higher than that measured. Bars at the bottom of the graph show deficiencies where the measured data are less than the reference contour as described in the fitting procedure for the STC, defined in ASTM E413-10. The shaded cells in the table and areas in the graph are outside the STC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. The reported values have been corrected according to the procedure outlined in ASTM E90-09. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level, in which case, the corrected values provide an estimate of the lower limit of airborne sound transmission loss.

ASTM E492 Test Results – Normalized Impact Sound Pressure Levels

Client: Nordic Engineered Wood **Test ID:** IIF-15-041

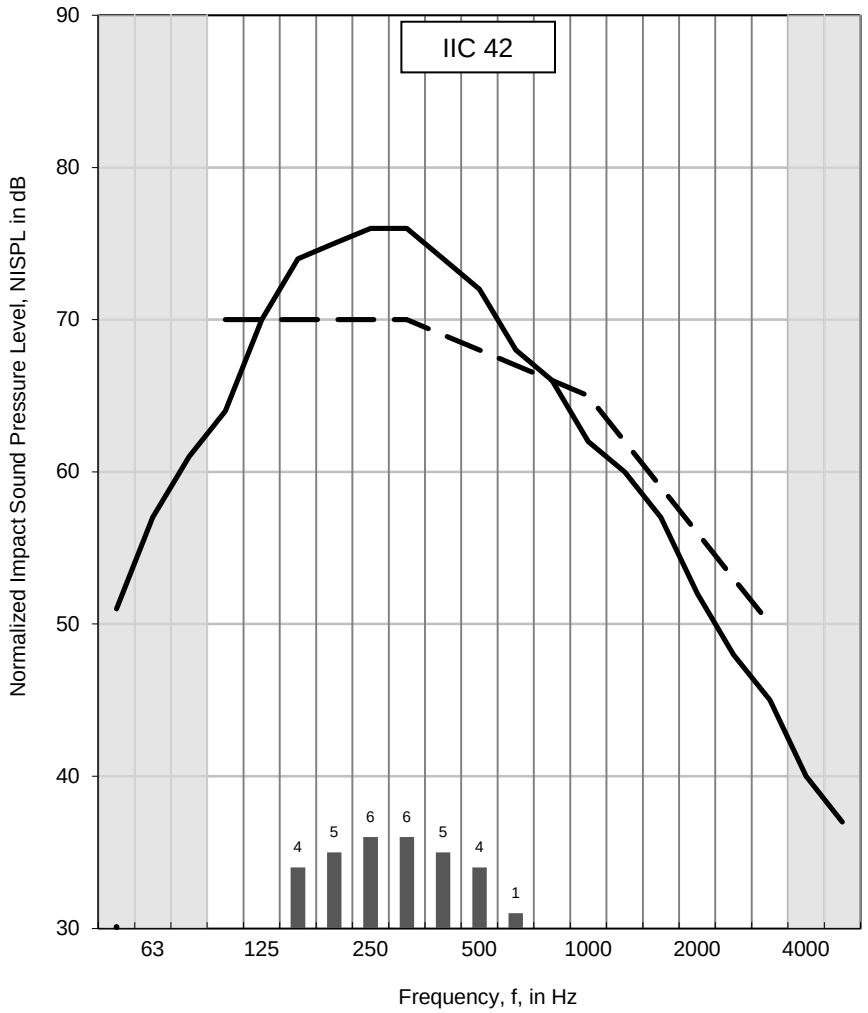
Specimen ID: A1-006070-33F **Date of Test:** June 22, 2015

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Upper	176.1	27.0 to 27.1	53.9 to 54.4
Lower	176.9	20.7 to 20.7	54.9 to 55.1

Area S of test specimen:	17.85 m^2
Mass per unit area:	212 kg/m^2

f (Hz)	NISPL (dB)
50	51
63	57
80	61
100	64
125	70
160	74
200	75
250	76
315	76
400	74
500	72
630	68
800	66
1000	62
1250	60
1600	57
2000	52
2500	48
3150	45
4000	40
5000	37
Impact Insulation Class (IIC)	**42**

Sum of Positive Differences (dB)
31
Max. Positive Difference (dB)
6 dB at 250 and 315 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Measurements of normalized impact sound pressure level (NISPL) were conducted in accordance with the requirements of ASTM E492-09, "Standard Laboratory Measurement of Impact Sound Transmission through Floor-Ceiling Assemblies Using the Tapping Machine".**

In the graph:
The solid line is the measured normalized impact sound pressure level (NISPL) for this specimen. The dashed line is the IIC contour fitted to the measured values according to ASTM E989-06. The dotted line is the background sound level measured in the receiving room during this test (may be below the displayed range). For any frequency where measured NISPL is less than 10 dB above the dotted line, the reported values were adjusted as noted below. Bars at bottom of graph show positive differences; where the measured data are greater than the reference contour as defined in ASTM E989-06. Shaded cells in the table and areas in the graph are outside the IIC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level and the reported values of NISPL provide an estimate of the upper limit of normalized impact sound pressure level, according to the procedure outlined in ASTM E492-09. The reported values of NISPL have been corrected according to the procedure outlined in ASTM E492-09.

Client Nordic Engineered Wood
1100 Ave des Canadiens-de-Montreal
Montreal QC H3B 2S2

Specimen Carpet tiles on 70 mm cement mortar precast slab on 13 mm (1/2") rubber membrane placed on top of a 89 mm (3-1/2") glulam decking floor

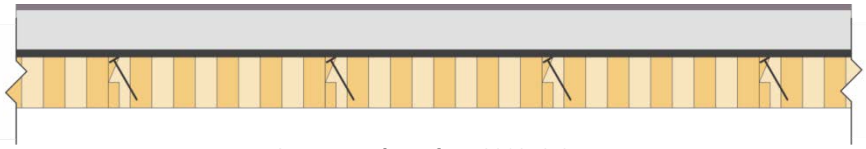
Specimen ID A1-006070-34F

Construction Date: June 25, 2015 to June 26, 2015

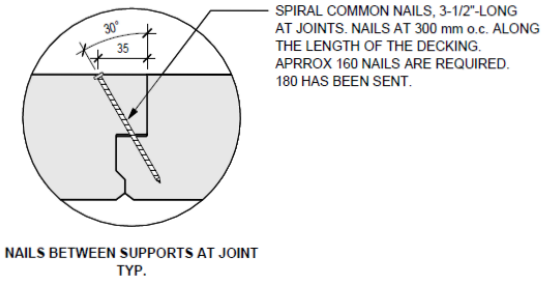
Specimen Description

The specimen was composed of glued-laminated timber (glulam) decking panels ranging from 270 mm to 384 mm wide x 89 mm thick x 3890 mm long. The combined panels filled the entire floor opening of the test frame. The glulam decking were joined using 90 mm (3-1/2") long common nails spaced 300 mm (12") on centre along the joints. The glulam decking floor was resting on the lip of the test frame and was not fastened to the test frame. The air gaps between the edges of the glulam decking floor and the test frame were filled with glass fiber insulation and covered with cloth tape. Duct putty was installed around the lower perimeter of the test frame and the glulam.

Carpet tiles 7 mm thick were adhered to a 70 mm cement mortar precast slab placed on a 13 mm (1/2") INSONOMAT rubber membrane which was placed on the glulam decking floor.



Cross-section of A1-006070-34F



Fastening details of glulam decking

Specimen Properties

Element	Actual thickness (mm)	Mass (kg)	Mass/length, area or volume
7 mm Carpet Tiles	7	50	2.6 kg/m^2
70 mm Cement Mortar Precast Slab	70	3243	162.0 kg/m^2
13 mm INSONOMAT Rubber Membrane	13	90	4.5 kg/m^2
89 mm Glulam Decking	89	912	45.6 kg/m^2
Total	**179**	**4295**	**215 kg/m^2**

Test Specimen Installation

- The exposed area of the floor specimen used for the calculations of the airborne sound transmission loss was 17.85 m^2 (4.71 m x 3.79 m).
- The total area of the floor assembly resting on top of the lip was 19.32 m^2 (4.88 m x 3.96 m).
- The mass per area of the elements above the lip was calculated using the total area (19.32 m^2).

ASTM E90 Test Results – Airborne Sound Transmission Loss

Client: Nordic Engineered Wood **Test ID:** TLF-15-049

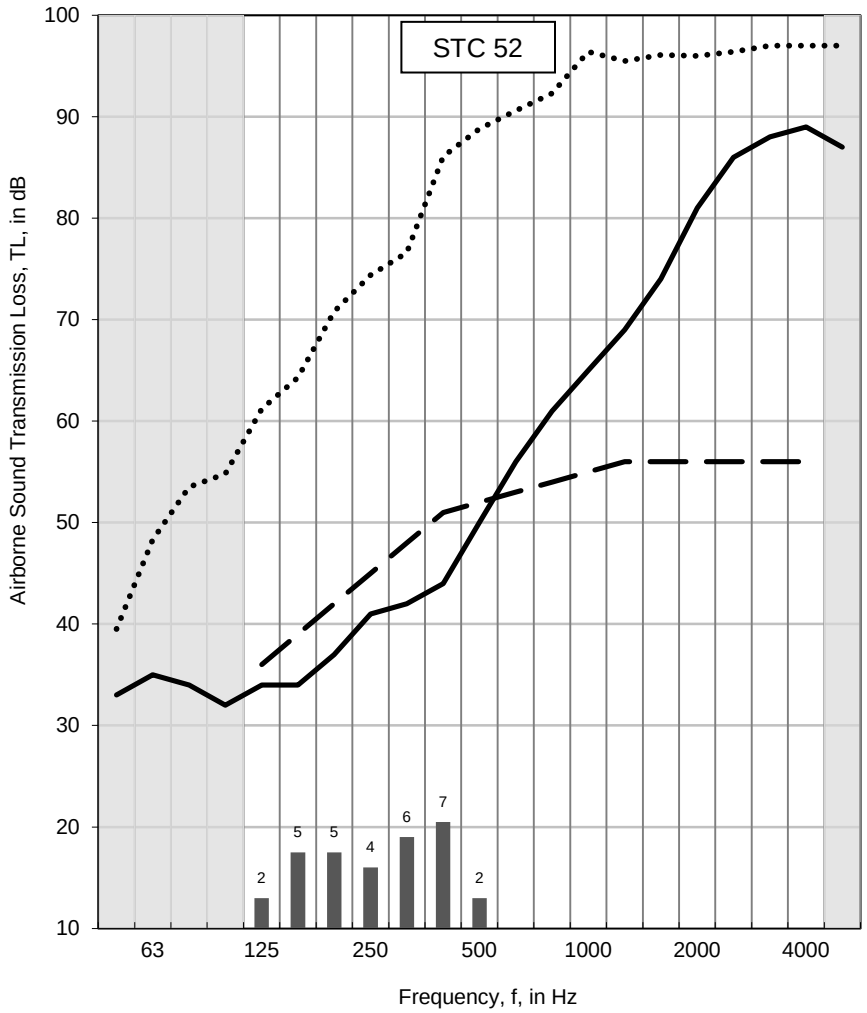
Specimen ID: A1-006070-34F **Date of Test:** June 26, 2015

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Upper	176.0	25.9 to 26.0	39.1 to 39.4
Lower	176.9	21.6 to 21.6	57.3 to 57.5

Area S of test specimen:	17.85 m^2
Mass per unit area:	215 kg/m^2

f (Hz)	Airborne TL (dB)	
50	33	
63	35	
80	34	
100	32	
125	34	
160	34	
200	37	
250	41	
315	42	
400	44	
500	50	
630	56	
800	61	
1000	65	
1250	69	
1600	74	
2000	81	
2500	86	c
3150	88	c
4000	89	c
5000	87	c
Sound Transmission Class (STC)	**52**	

Sum of Deficiencies (dB)
31
Max. Deficiency (dB)
7 dB at 400 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Airborne sound transmission loss measurements were conducted in accordance with the requirements of ASTM E90-09, "Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements".**

In the graph:
The solid line is the measured sound transmission loss for this specimen. The dashed line is the STC contour fitted to the measured values according to ASTM E413-10. The dotted line (may be above the displayed range) is 10 dB below the flanking limit established for this facility. For any frequency band where the measured transmission loss is above the dotted line, the reported value is potentially limited by flanking transmission via laboratory surfaces, and the true value may be higher than that measured. Bars at the bottom of the graph show deficiencies where the measured data are less than the reference contour as described in the fitting procedure for the STC, defined in ASTM E413-10. The shaded cells in the table and areas in the graph are outside the STC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. The reported values have been corrected according to the procedure outlined in ASTM E90-09. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level, in which case, the corrected values provide an estimate of the lower limit of airborne sound transmission loss.

ASTM E492 Test Results – Normalized Impact Sound Pressure Levels

Client: Nordic Engineered Wood **Test ID:** IIF-15-042

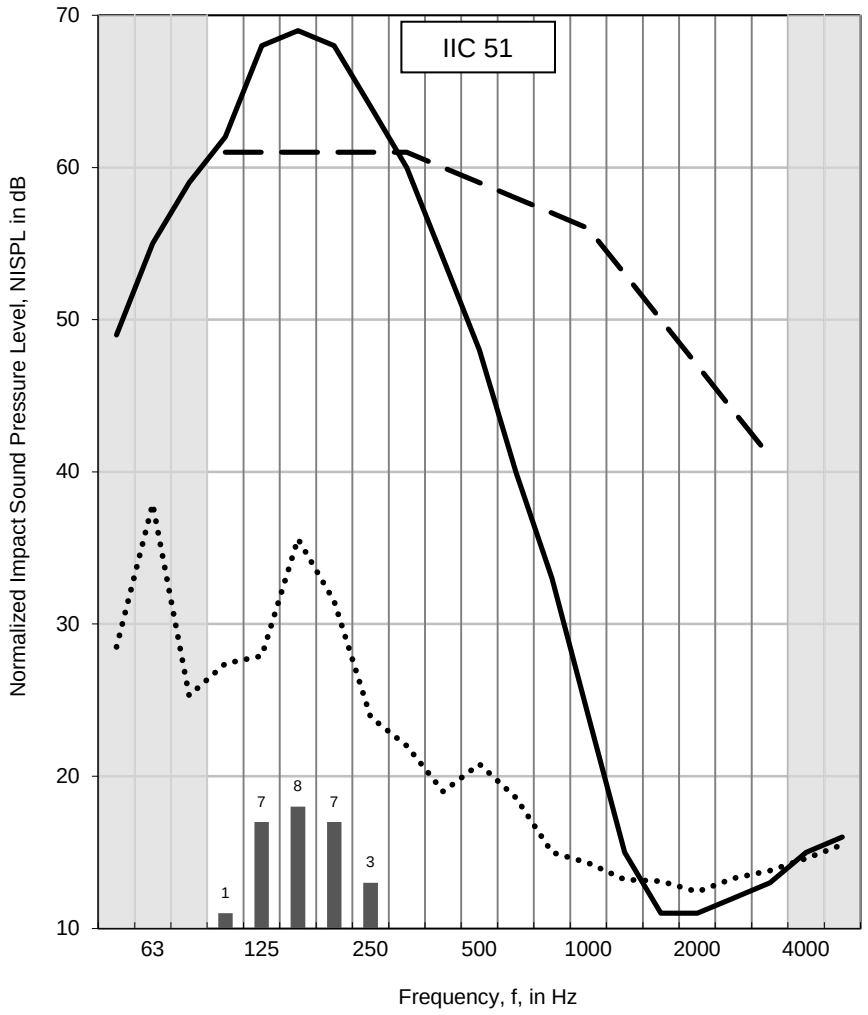
Specimen ID: A1-006775-34F **Date of Test:** June 26, 2015

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Upper	176.0	25.2 to 25.6	37.5 to 40.1
Lower	176.9	21.7 to 22.0	56.7 to 57.3

Area S of test specimen:	17.85 m^2
Mass per unit area:	215 kg/m^2

f (Hz)	NISPL (dB)	
50	49	
63	55	
80	59	
100	62	
125	68	
160	69	
200	68	
250	64	
315	60	
400	54	
500	48	
630	40	
800	33	
1000	24	c
1250	15	*
1600	11	*
2000	11	*
2500	12	*
3150	13	*
4000	15	*
5000	16	*
Impact Insulation Class (IIC)	**51**	

Sum of Positive Differences (dB)
26
Max. Positive Difference (dB)
8 dB at 160 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Measurements of normalized impact sound pressure level (NISPL) were conducted in accordance with the requirements of ASTM E492-09, "Standard Laboratory Measurement of Impact Sound Transmission through Floor-Ceiling Assemblies Using the Tapping Machine".**

In the graph:
The solid line is the measured normalized impact sound pressure level (NISPL) for this specimen. The dashed line is the IIC contour fitted to the measured values according to ASTM E989-06. The dotted line is the background sound level measured in the receiving room during this test (may be below the displayed range). For any frequency where measured NISPL is less than 10 dB above the dotted line, the reported values were adjusted as noted below. Bars at bottom of graph show positive differences; where the measured data are greater than the reference contour as defined in ASTM E989-06. Shaded cells in the table and areas in the graph are outside the IIC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level and the reported values of NISPL provide an estimate of the upper limit of normalized impact sound pressure level, according to the procedure outlined in ASTM E492-09. The reported values of NISPL have been corrected according to the procedure outlined in ASTM E492-09.

APPENDIX: ASTM E90-09 – Airborne Sound Transmission – Wall Facility

Facility and Equipment: The NRC Construction Wall Sound Transmission Facility comprises two reverberation rooms (referred to in this report as the large and small rooms) with a moveable test frame between the two rooms. The large room has an approximate volume of 255 m^3 while the small room has an approximate volume of 140 m^3. In each room, a calibrated Bruel & Kjaer condenser microphone (type 4166 or 4165) with preamp is moved under computer control to nine positions, and measurements are made in both rooms using an 8-channel National Instrument NI-4472 system installed in a computer. Each room has four bi-amped loudspeakers driven by separate amplifiers and noise sources. To increase randomness of the sound field, there are fixed diffusing panels in each room.

Test Procedure: Airborne sound transmission measurements were conducted in accordance with the requirements of ASTM E90-09, "Standard Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions". Airborne sound transmission loss tests were performed in the forward (receiving room is the large room) and reverse (receiving room is the small room) directions. Results presented in this report are the average of the tests in these two directions. In each case, sound transmission loss values were calculated from the average sound pressure levels of both the source and receiving rooms and the average reverberation times of the receiving room. One-third octave band sound pressure levels were measured for 32 seconds at nine microphone positions in each room and then averaged to get the average sound pressure level in each room. Five sound decays were averaged to get the reverberation time at each microphone position in the receiving room; these reverberation times were averaged to get the average reverberation times for each room. Information on the flanking limit of the facility and reference specimen test results are available on request.

Significance of Test Results: ASTM E90-09 requires measurements in 1/3-octave bands in the frequency range 100 Hz to 5000 Hz. Within those ranges, reproducibility has been assessed by inter-laboratory round robin studies. The standards recommend making measurements and reporting results over a larger frequency range, and this report presents such results, which may be useful for expert evaluation of the specimen performance. The precision of results outside the 100 to 5000 Hz range has not been established, but is expected to depend on laboratory-specific factors.

Sound Transmission Class (STC): The Sound Transmission Class (STC) was determined in accordance with ASTM E413-10, "Classification for Rating Sound Insulation". It is a single-figure rating scheme intended to rate the acoustical performance of a partition element separating offices or dwellings. The higher the value of the rating, the better the performance. The rating is intended to correlate with subjective impressions of the sound insulation provided against the sounds of speech, radio, television, music, and similar sources of noise characteristic of offices and dwellings. The STC is of limited use in applications involving noise spectra that differ markedly from those referred to above (for example, heavy machinery, power transformers, aircraft noise, motor vehicle noise). Generally, in such applications it is preferable to consider the source levels and insulation requirements for each frequency band.

In Situ Performance: Ratings obtained by this standard method tend to represent an upper limit to what might be measured in a field test, due to structure-borne transmission ("flanking") and construction deficiencies in actual buildings.

APPENDIX: ASTM E90-09 – Airborne Sound Transmission – Floor Facility

Facility and Equipment: The NRC Construction Floor Sound Transmission Facility comprises two reverberation rooms (referred to in this report as the upper and lower rooms) with a moveable test frame between the rooms. Both rooms have an approximate volume of 175 m^3. In each room, a calibrated Bruel & Kjaer condenser microphone (type 4166 or 4165) with preamp is moved under computer control to nine positions, and measurements are made in both rooms using an 8-channel National Instrument NI-4472 system installed in a computer. Each room has four bi-amped loudspeakers driven by separate amplifiers and noise sources. To increase randomness of the sound field, there are fixed diffusing panels in each room.

Test Procedure: Airborne sound transmission measurements were conducted in accordance with the requirements of ASTM E90-09, "Standard Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions". Airborne sound transmission loss tests were performed in the forward (receiving room is the lower room) and reverse (receiving room is the upper room) directions. Results presented in this report are the average of the tests in these two directions. In each case, sound transmission loss values were calculated from the average sound pressure levels of both the source and receiving rooms and the average reverberation times of the receiving room. One-third octave band sound pressure levels were measured for 32 seconds at nine microphone positions in each room and then averaged to get the average sound pressure level in each room. Five sound decays were averaged to get the reverberation time at each microphone position in the receiving room; these reverberation times were averaged to get the average reverberation times for each room. Information on the flanking limit of the facility and reference specimen test results are available on request.

Significance of Test Results: ASTM E90-09 requires measurements in 1/3-octave bands in the frequency range 100 Hz to 5000 Hz. Within those ranges, reproducibility has been assessed by inter-laboratory round robin studies. The standards recommend making measurements and reporting results over a larger frequency range, and this report presents such results, which may be useful for expert evaluation of the specimen performance. The precision of results outside the 100 to 5000 Hz range has not been established, but is expected to depend on laboratory-specific factors.

Sound Transmission Class (STC): The Sound Transmission Class (STC) was determined in accordance with ASTM E413-10, "Classification for Rating Sound Insulation". It is a single number rating scheme intended to rate the acoustical performance of a partition element separating offices or dwellings. The higher the value of the rating, the better the performance. The rating is intended to correlate with subjective impressions of the sound insulation provided against the sounds of speech, radio, television, music, and similar sources of noise characteristic of offices and dwellings. The STC is of limited use in applications involving noise spectra that differ markedly from those referred to above (for example, heavy machinery, power transformers, aircraft noise, motor vehicle noise). Generally, in such applications it is preferable to consider the source levels and insulation requirements for each frequency band.

In Situ Performance: Ratings obtained by this standard method tend to represent an upper limit to what might be measured in a field test, due to structure-borne transmission ("flanking") and construction deficiencies in actual buildings.

APPENDIX: ASTM E492-09 – Light Impact Sound Transmission – Floor Facility

Facility and Equipment: The NRC Construction Floor Sound Transmission Facility comprises two reverberation rooms (referred to in this report as the upper and lower rooms) with a moveable test frame between the two rooms. Both rooms have an approximate volume of 175 m^3. For impact sound transmission, only the lower room is used. A calibrated Bruel & Kjaer condenser microphone (type 4166 or 4165) with preamp is moved under computer control to nine positions, and measurements are made using an 8-channel National Instrument NI 4472 system installed in a computer. The room has 4 bi-amped loudspeakers driven by separate amplifiers and incoherent noise sources. To increase randomness of the sound field, there are fixed diffusing panels in the room.

Test Procedure: Impact sound transmission measurements were conducted in accordance with ASTM E492-09, "Standard Test Method for Laboratory Measurement of Impact Sound Transmission Through Floor-Ceiling Assemblies Using the Tapping Machine". This method uses a standard tapping machine placed at four prescribed positions on the floor. One-third octave band sound pressure levels were measured for 32 seconds at each microphone position in the receiving room and then averaged to get the average sound pressure level in the room. Five sound decays were averaged to get the reverberation time at each microphone position in the receiving room; these nine reverberation times were averaged to get the spatial average reverberation times for the room. The spatial-average sound pressure levels and reverberation times of the receiving room were used to calculate the Normalized Impact Sound Pressure Levels.

Significance of Test Results: ASTM E492-09 requires measurements in 1/3-octave bands in the frequency range 100 Hz to 3150 Hz. Within this range, reproducibility has been assessed by inter-laboratory round robin studies. The standard recommends making measurements and reporting results over a larger frequency range, and this report presents such results, which may be useful for expert evaluation of the specimen performance. The precision of results outside the standard ranges has not been established, and is expected to depend on laboratory-specific factors such as room size and specimen dimensions.

Impact Insulation Class (IIC): The Impact Insulation Class (IIC) was determined in accordance with ASTM E989-06, "Standard Classification for Determination of Impact Insulation Class (IIC)". It is a single number rating scheme intended to rate the effectiveness of floor-ceiling assemblies at preventing the transmission of impact sound from the standard tapping machine. A higher IIC value indicates a better floor performance.

In Situ Performance: Ratings obtained by this standard method tend to represent an upper limit to what might be measured in a field test, due to structure-borne transmission ("flanking") and construction deficiencies in actual buildings