

Studies on sound insulation of timber building - 1



National Institute for Land and Infrastructure Management (NILIM)

Building Research Institute (BRI)

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1. Introduction

- Building Research Institute (BRI) and National Institute for Land and Infrastructure Management (NILIM) have carried out some investigations into sound insulation of timber buildings.
- These panels show the research results of timber sound insulation in some projects.

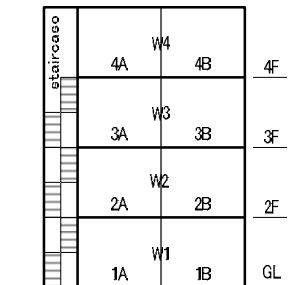
2. Project A - Floor impact sound insulation performance of the wood-framed model building for experiments

- Building Research Institute and Japan 2x4 Home Builders Association conducted joint research on the fire-resistance of the wood-framed constructions and developed a wooden fire-resistant construction.
- The floor impact sound insulation performances of the wood-framed model building for experiments was investigated.

Model building of the wood-framed model building for experiments



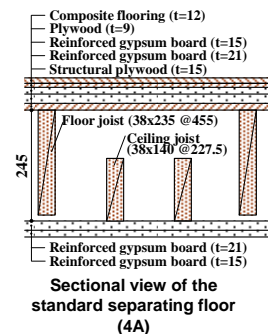
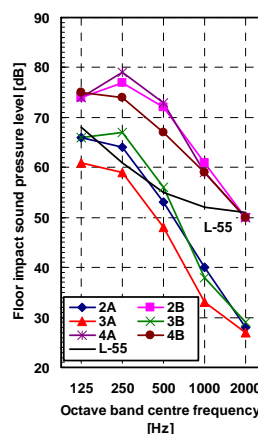
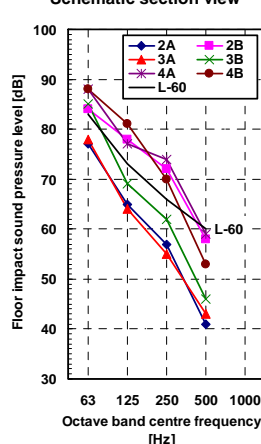
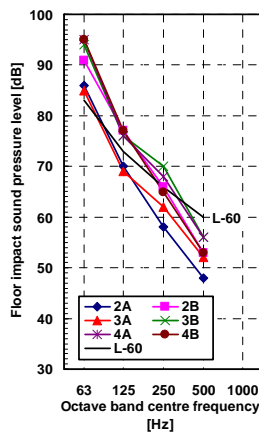
Appearance



Schematic section view

Separating floors	Specifications
4A (Standard)	Fire-resistant specifications + composite flooring (12)
4B	Fire-resistant specifications + asphalt sound-insulation sheet (8) + composite flooring (12)
3A	Fire-resistant specifications + floating floor A
3B	Fire-resistant specifications + floating floor B
2A	Fire-resistant specifications + floating floor C*
2B	Fire-resistant specifications + damping material* inserted for sound insulation

Note: The asterisked floating floor C and damping material were trial products. The numbers in parentheses indicate thickness.



• The floating floors are effective for the floor impact sound insulation in wood-framed constructions.

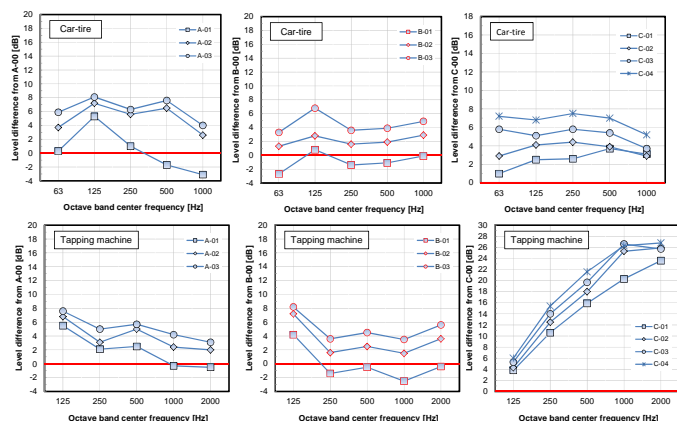
Results of floor impact sound levels measurements

3. Project B - Influence on floor impact sound insulation in wood-frame construction due to resilient channels and floating floor

- The influence on floor impact sound insulation in wood-frame construction due to resilient channels and floating floor were investigated.

Separation Floor	Specifications
A-00(Reference floor)	PW12 + PW15 + FJ + GB12.5
A-01	PW12 + PW15 + FJ + SR + GB12.5
A-02	PW12 + PW15 + FJ + SR + GB12.5 + GB12.5
A-03	PW12 + PW15 + FJ + SR + GB12.5 + GB12.5 + GB12.5
B-00(Reference floor)	PW12 + PW15 + FJ + CJ + GB12.5
B-01	PW12 + PW15 + FJ + CJ + SR + GB12.5
B-02	PW12 + PW15 + FJ + CJ + SR + GB12.5 + GB12.5
B-03	PW12 + PW15 + FJ + CJ + SR + GB12.5 + GB12.5 + GB12.5
C-00(Reference floor)	CF12 + PW15 + FJ + G/W + GB12.5 + GB12.5
C-01	Floating floor 1 + C-00
C-02	Floating floor 2 + C-00
C-03	Floating floor 3 + C-00
C-04	Floating floor 4 + C-00

- The double or triple layer ceiling board is effective to improve floor impact sound insulation of ceilings with resilient channels.
- The effects of the resilient channels on the floor impact sound insulation for the direct ceiling were larger than that for the independent ceiling.
- There were the effects on heavy-weight and light-weight floor impact sound insulation by using floating floors.



Level differences in floor impact sound levels from reference floor

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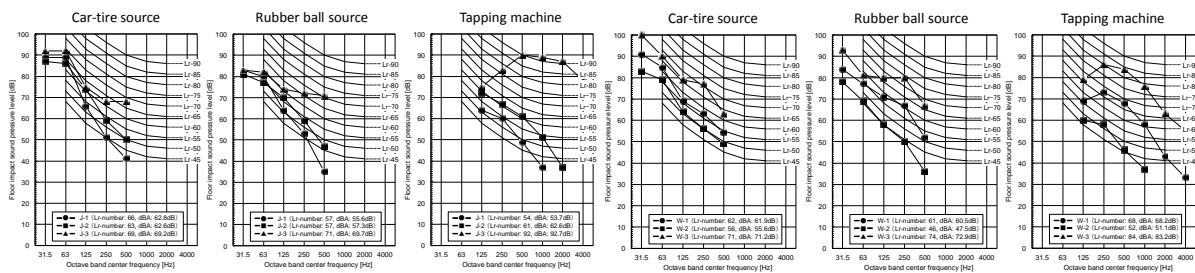
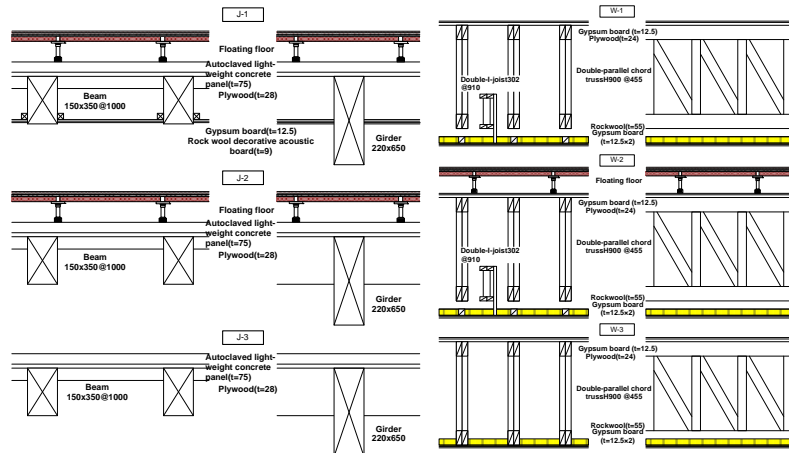


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4. Project C - Floor impact sound insulation of wooden three-story school building for full-scale fire experiment

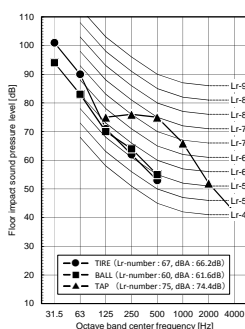
- A three-story school building (specimen) was constructed with one-hour quasi-fireproof rated members and systems and subjected to a full-scale fire experiment.
- The measurement results of floor impact sound insulation of the wooden three-story school building were indicated.



- There are the effects on heavy-weight and light-weight floor impact sound insulation by using floating floors and the independent ceiling.
- It was found that the frequency properties of the reduction of transmitted floor impact sound level of the floating floor had showed different results depending on the floor construction method.

5. Project D - Floor impact sound insulation of timber three-story school building for final full-scale fire test

- The timber three-story school buildings with one-hour quasi-fire-resistive construction were constructed as specimen, and full-scale fire tests were conducted three times (i.e., preliminary test, preparatory test and final test) in order to review the technical criteria regarding quasi-fire-resistive performance.



- The composited calculation results of A-weighted floor impact sound pressure levels are shown as well.
- The heavy-weight floor impact sound insulation using the car-tire source was Lr-65 or 66.2 dBA and the light-weight floor impact sound insulation was Lr-75 or 74.4 dBA.
- The reduced section design increased the weight and rigidity of the floor cross-sectional structure and improved the floor impact sound insulation.
- As the impedance method that is estimated the floor impact sound insulation, the floor impact sound insulation changes by the driving-point impedance of slab.
- The driving-point impedance of the floor cross-section with reduced sections and that without reduced sections were calculated.
- An effect of approximately 8 dB was confirmed by the reduced section design.

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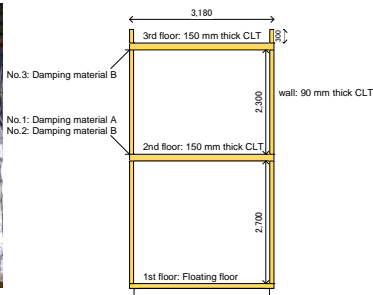


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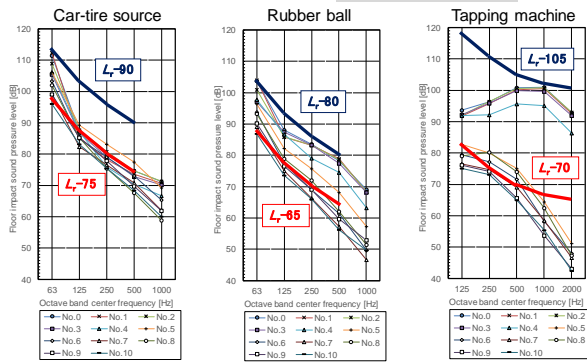
6. Project E - Improvement of floor impact sound insulation in cross laminated timber model building for experiment

- Cross laminated timber (CLT) was standardized by JAS (Japanese Agricultural Standard) as construction material in 2014.
- We built a 3-story cross laminated timber model building for experiments.
- We investigated the floor impact sound insulation and the effect of damping material, ceiling and floating floor on the floor impact sound insulation of cross laminated timber building.

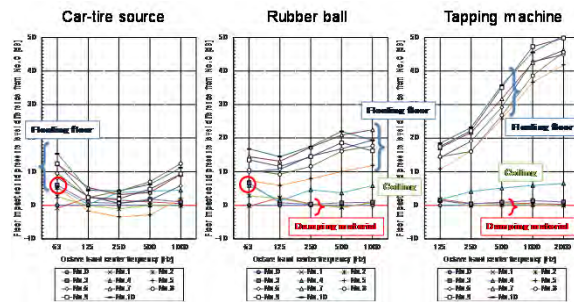


Outline of specimen

No.	Damping material	Ceiling	Floor topping
0	None		
1	Damping material A (between 2 nd floor wall and 2 nd floor)	None	None
2	Damping material B (between 2 nd floor wall and 2 nd floor)		
3	Damping material B (between 3 rd floor and 2 nd floor wall)		
4	None	Gypsum board, t=9.5 mm	Floating floor A
5		None	Floating floor B
6			Floating floor C
7			Floating floor A
8		Gypsum board, t=9.5 mm	Floating floor B
9			Floating floor C
10			



Measurement results of floor impact sound insulations



Improvements of Floor Impact Sound Pressure Levels from Specimen No. 0

- The results of the floor impact sound insulation suggest the influences of the damping material, ceiling and floating on the floor impact sound insulation of cross laminated timber building.
- We confirm that there becomes little sound radiation from wall surface by using damping material.
- We conclude that the effects on heavy-weight and light-weight floor impact sound insulation by using floating floors for cross laminated timber building.

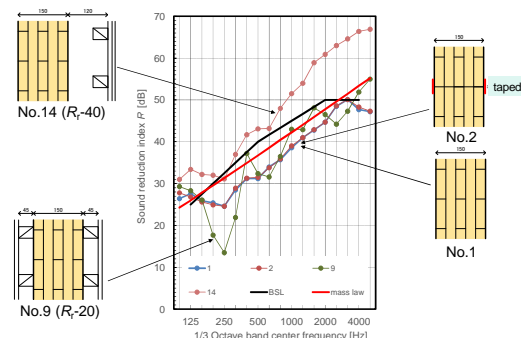
7. Project E - Effect of difference in specification on sound insulation in cross laminated timber separation wall

- We investigated the airborne sound insulation of CLT (Cross Laminated Timber) separation wall and the influence of specifications of specimen in laboratory measurement.
- The improvement of airborne sound insulation CLT separation wall was investigated.

Outline of specimen

No.	Sound-source room side	CLT	Sound-receiving room side
1		150mm thick	
2		150mm(taped between the CLT panels)	
3	GB(12.5)+FS(15)	150mm thick	
4	GB(12.5)+A(2.4)+FS(15)		
5	GB(12.5)+A(2.4)+FS(15)		FS(15)+A(2.4)+GB(12.5)
6	GB(9.5)+GB(12.5)+A(2.4)+FS(15)		FS(15)+A(2.4)+GB(12.5)
7	GB(9.5)+GB(12.5)+A(2.4)+FS(15)		FS(15)+A(2.4)+GB(12.5)+GB(9.5)
8	GB(12.5)+FS(45)		
9	GB(12.5)+FS(45)		FS(45)+GB(12.5)
10			AS(45), LGS(15)+GB(12.5)
11			AS(45), LGS(15)+GB(12.5)+GB(9.5)
12			AS(45), LGS(15)+GB(12.5)+GB(12.5)
13			AS(120), FS(45)+GB(12.5)
14			AS(120), FS(45)+GB(12.5)+GB(9.5)

Note: GB: Gypsum Board, FS: Furring Strip, A: Asphalt sheet, AS: Air layer, LGS: Light Gauge Steel, Parenthesized figures show the thickness.



Measurement results of airborne sound insulations

- The airborne sound insulation of 150mm thickness CLT panel is poor sound insulation.
- We proposed measures for the increase in airborne sound insulation of the CLT separation wall.