22nd International Congress on Acoustics
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Acoustics for the 21st Century...

Effect of difference in specification on sound insulation in cross laminated timber separation wall

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Introduction - Background

- Enforcement of ***the Act for Promotion of Use of Wood in Public Buildings*** (Law No. 36 of 2010 of Japan).
  - The purpose of this act is proper maintenance of the forest and an improvement of the rate of self-sufficiency of wood.
  - The promotion of the use of wood can contribute to the prevention of global warming.
- A public building in a low layer is supposed to attempt making to timber construction.
- It is expected that the building such as apartment house comes to be made from wooden.

Introduction - Background

- Cross laminated timber (CLT) was standardized by JAS (**J**apanese **A**gricultural **S**tandard) as construction material in 2014.
- The sound insulation of the apartment houses often becomes a problem.
- The sound insulation of the timber constructions is low compared with that of the concrete constructions.
- We have little knowledge about sound insulation of cross laminated timber building.

Introduction - Background

- 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.

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The Building Standard Law

THE BUILDING STANDARD LAW

(Separation Walls between Each Unit of Row Houses or Apartment Houses)

Article 30. Separation walls between each unit of row houses or apartment houses shall extend into attic space or above ceilings and **shall be of a construction which conforms to technical criteria** specified by Cabinet Order concerning sound insulation performance (performance of separation walls necessary to reduce sound generated by daily life from adjoining units without adversely affecting sanitation) and which uses construction methods established by the Minister of Land, Infrastructure, Transport and Tourism or which was approved by the Minister.

The Building Standard Law

THE BUILDING STANDARD LAW ENFORCEMENT ORDER

(Technical Criteria for Sound Insulation Performance)

Article 22-3. Technical criteria specified by Cabinet Order under Article 30 of the Law **shall be such that, for the frequency of sound specified in the left column of the following table, the transmission loss shall be not less than the corresponding value listed in the right column.**

Frequency, Hz	Transmission loss, db
125	25
500	40
2 000	50

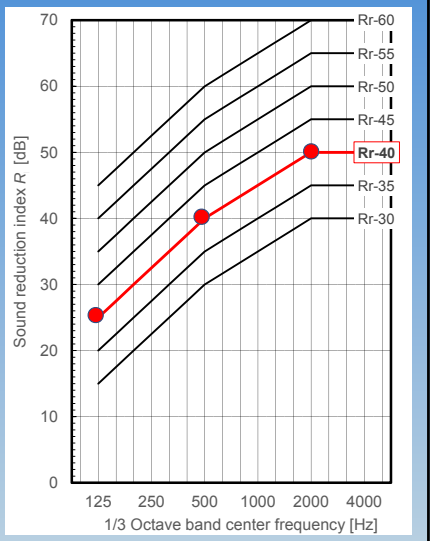
The Building Standard Law

- the single-number quantity : R_r (defined in JIS A 1419-1)

Frequency, Hz	Transmission loss, db
125	25
500	40
2 000	50

- It is necessary that the sound insulation is more than the single-number quantity R_r **-40** as separation wall between each unit of apartment houses.

reference curves



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Measurement Overview

- The sound reduction index R is measured in conformity with **JIS A 1416** (or **ISO 10140-2**) for laboratory measurement.

$$R = L_1 - L_2 + 10\lg(S/A)$$

L_1: the energy-average sound pressure level in the source room

L_2: the energy-average sound pressure level in the receiving room

S : the area of the common wall

A : the equivalent absorption are of the receiving room

- The single-number quantity R_r was evaluated **with JIS A 1419-1**.

Measurement Overview

- The opening sizes of reverberation chamber is approximately 10 m^2.
- The volume of source room is approximately 66 m^3.
- The volume of receiving room is approximately 60 m^3.

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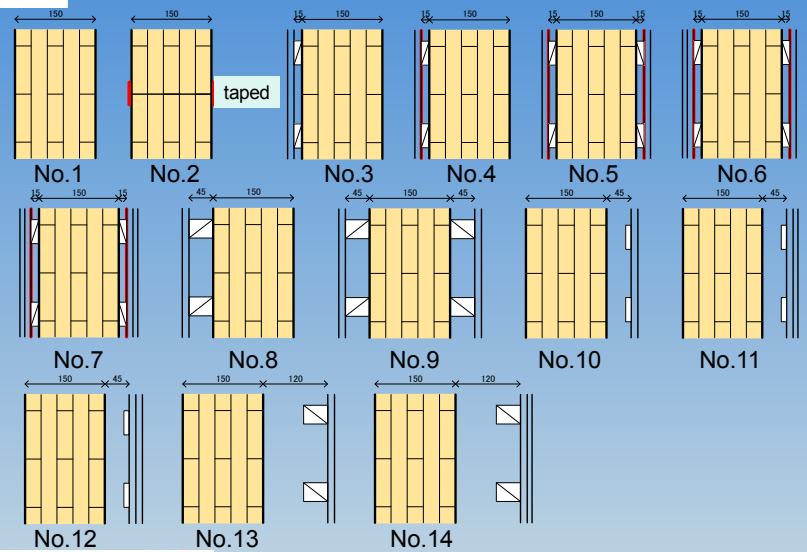
Outline of specimen of separation wall

- The specimens assumed 150 mm thickness CLT panel, which had 5-ply and 5-layer, and measured the airborne sound insulation for 14 specimens.

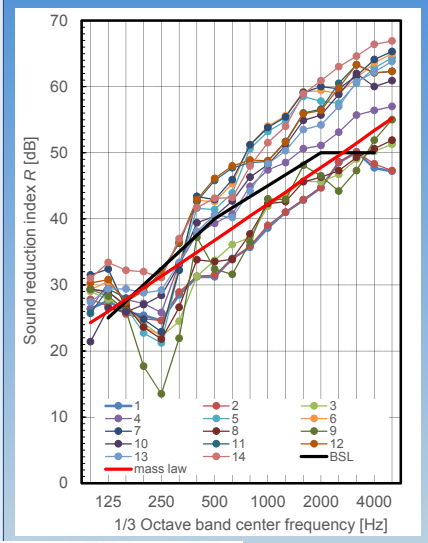
No.	Sound-source room side	CLT	Sound-receiving room side
1	–	150mm thick	–
2	–	150mm(taped between the CLT panels)	–
3	GB(12.5)+FS(15)	150mm thick	–
4	GB(12.5)+A(2.4)+FS(15)	↑	–
5	GB(12.5)+A(2.4)+FS(15)	↑	FS(15)+A(2.4)+GB(12.5)
6	GB(9.5)+GB(12.5)+A(2.4)+FS(15)	↑	FS(15)+A(2.4)+GB(12.5)
7	GB(9.5)+GB(12.5)+A(2.4)+FS(15)	↑	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)

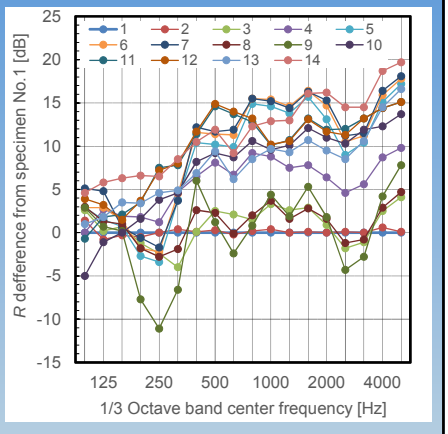
Note; GB: Gypsum Board, FS: Furring Strip, A: Asphalt sheet, AS: Air layer, LGS: Light Gauge Steel, Parenthesized figures show the thickness.

Sectional view of separation wall for specimen

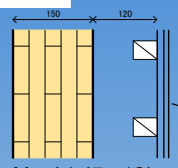


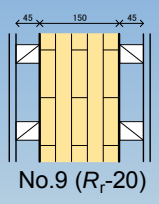
Measurement results of airborne sound insulations

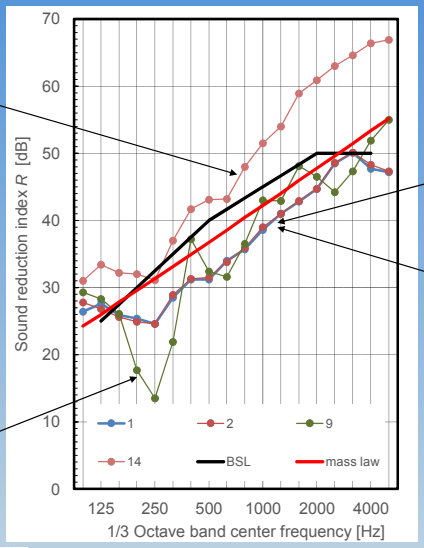


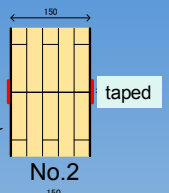


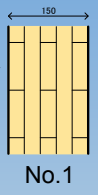
Measurement results of airborne sound insulations











Examination of the increase in airborne sound insulation

1. Increase of rigid of CLT

- As the measures that performance decreases from mass law, the rigidity of CLT is increased by applying mortar, resin and so on.

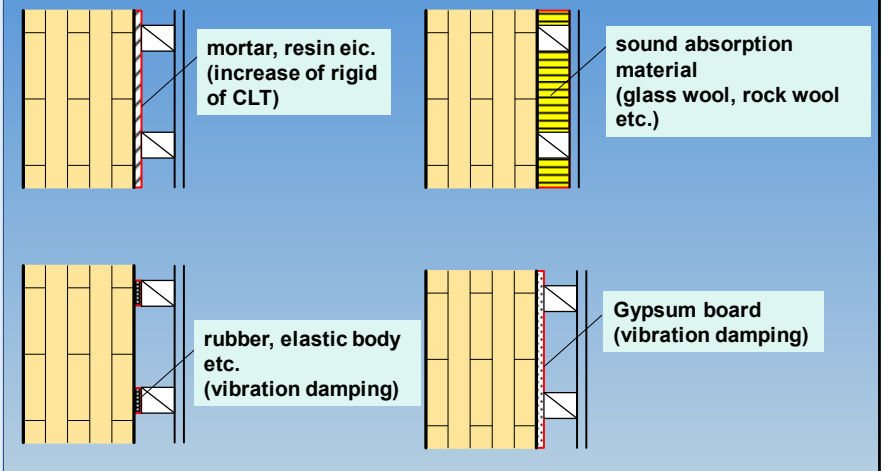
2. Insertion of the sound absorption material

- The airborne sound insulation is improved by insertion of the sound absorption material between CLT panel and gypsum board.

3. Vibration damping from CLT panel to gypsum board

- Setting of the gypsum board wall independent of CLT.
- Installing the damping material on the furring strip.

Examination of the increase in airborne sound insulation



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Conclusions

- We had the experimental examination about the airborne sound insulation of the CLT (Cross Laminated Timber) separation wall.
- 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.


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