RESEARCH HIGHLIGHTS

Technical Series 00-109

# SUMMARY REPORT FOR CONSORTIUM ON FIRE RESISTANCE AND SOUND INSULATION OF FLOORS: SOUND TRANSMISSION CLASS AND IMPACT INSULATION CLASS RESULTS

## Introduction

Due to recent changes in code requirements for sound attenuation it was necessary to determine cost effective ways to achieve desired STC and IIC levels. A variety of materials, and floor assemblies needed to be compared to determine which combinations satisfied acoustic and cost considerations.

The project tested 190 specimens in a specially constructed chamber to provide the data needed to answer these questions. A separate report considers the effect sound attenuation measures may have on the fire resistance of floor assemblies.

This research report outlines the results of a series of tests on typical residential floor assemblies and materials that might be used to achieve desired sound insulation ratings. The report summarizes conclusions, which tend to support or refute common assumptions about typical materials, designs and construction practices.

The report focuses on two common rating formats for sound transmission: Sound Transmission Class (STC), and Impact Insulation Class (IIC). The results enable practitioners to make educated decisions when comparing options for floor assemblies in the field.

This research was undertaken by the IRC Acoustics Laboratory of the National Research Council and was supported by a consortium including: Boise Canada, Canada Mortgage and Housing Corporation (CMHC), Canadian Home Builders' Association (CHBA), Canadian Portland Cement Association (CPCA), Canadian Sheet Steel Building Institute (CSSBI), Canadian Wood Council (CWC), Cellulose Insulation Manufacturers Association of Canada (CIMAC), Forintek Canada Corporation (FORINTEK), Gypsum Association, Gypsum Manufacturers of Canada (GMC), Louisiana-Pacific Incorporated, Nascor Inc., Ontario New Home Warranty Program, Ontario Ministry of Housing, Owens Corning Fiberglass Canada Inc. (OCFCI), Roxul Inc. (ROXUL), Truss Joist MacMillan, and Willamette Industries.

## Research Program

The assemblies were built using normal construction practices. A typical floor assembly was tested and rebuilt several times to act as a reference floor in order to gauge the repeatability and reproducibility value of the test protocol. Some experimental assemblies were also tested.

Sound transmission loss (TL) and sound transmission class (STC) were calculated according to ASTM E413, using loudspeakers.

Impact sound was measured in accordance with ASTM E492, and impact insulation class (IIC) was calculated according to ASTM E989, using a tapping machine.

CMHC SCHL

HOME TO CANADIANS

Canada

The report contains a diagram and test result chart for each series of tests on a floor assembly type. The thickness and type of floor joist, sub floor, gypsum, and insulation were varied to determine how the different configurations affected sound control. Other variables such as joist length, fastener spacing and tightness, and the use of adhesives and resilient channels were also tested.

For instance, assemblies using solid wood joists were compared with assemblies using composite I joists, wood trusses, and steel joists.

Variables tested include:

- solid wood and steel joists, composite I joists, and wood trusses, their depth and spacing
- glass fibre batts, mineral fibre batts, and sprayed on cellulose, in varying thicknesses and positions
- single and double layers of subflooring and gypsum ceilings
- resilient metal channels, resilient steel studs, U channels, wire supports, and wood furring
- wood floor assemblies with concrete topping
- uniform and rib slab concrete floors.

## Findings

- Performance is most influenced by the sum of the masses per unit area of the floor and ceiling layers
- Performance can be improved by increasing the thickness and density of the insulation
- Results for wood I joists showed significant variation, while trusses showed low IIC results
- There was no difference between floors using cross bracing or strapping
- Floors with concrete toppings and without resilient channels have poor IIC ratings.

Good practice that improves sound control may reduce fire control, and good practice that improves fire control may not improve sound control. For instance, for better fire resistance in single layer gypsum ceilings, the gypsum board can be suspended with additional channel at butt edges, however this practice can lower STC and IIC ratings by 2 dB. Two layer gypsum board ceilings are not significantly affected by the same practice.

Several key findings are of interest to the building industry:

- several common methods or beliefs were found not to be effective:
  - results were not affected by increasing the number or tightness of screws or nails, or by the use of adhesives
  - the location of the insulation within the joist cavity does not matter
  - placing resilient channels between two layers of drywall gave poor performance
- some techniques are essential to achieve rated floor assemblies:
  - joist floors require resilient metal channels to achieve STC 50, with or without insulation
- some desirable techniques may reduce costs:
  - performance can be improved by increasing the depth and spacing of the joists, and by increasing the spacing of the resilient channels
  - adding resilient surface layers over concrete toppings greatly improves IIC ratings.

## Implications for the Housing Industry

There are many ways to build a floor assembly to meet acoustic targets, using common building materials. Some common field practices are not effective.

Cost effective floor assemblies require resilient channels to achieve STC 50 ratings.

Adding more insulation, or denser insulation improves acoustic performance, however it is not significant without resilient channels.

Increasing the depth and spacing of the joists and the spacing of the resilient channels improves acoustic performance.

Adding resilient channels to floors with concrete surfaces significantly improves IIC ratings.

Resilient channel between two layers of drywall is not effective.

Using resilient channel to support butt ends of single layer gypsum boards reduces acoustic performance.

Adding resilient surfaces to concrete toppings significantly improves IIC ratings.

## Additional Research Needs

More research is needed:

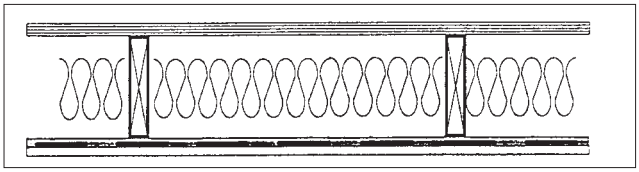
- to determine why some common building materials such as trusses and I joists produced unpredictable variations
- to determine the measurable improvement related to using higher density insulation
- to determine the impact of dense packing insulation
- to improve the accuracy of prediction models.

A separate project is exploring the influence of floor toppings on impact sound insulation.

## Table 1 Solid Wood Joists—Single layer subfloors and one or two ceiling layers

| | |
|---|---|
| Joist Depth | 235 mm |
| Joist Spacing | 406 mm o.c. |
| Cavity filling | 152 mm glass fiber batts |
| Resilient channels | 610 mm o.c. |

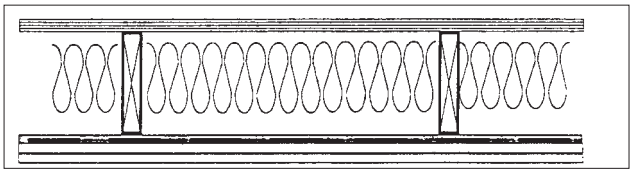
**(a) Single layer subfloor and ceiling**



| Subfloor material | Subfloor thickness, mm | Gypsum board thickness, mm | Test ID | STC | Test ID | IIC |
|---|---|---|---|---|---|---|
| OSB | 15 | 12.7[1] | TLF-95-155a | 49 | IIF-95-059 | 43 |
| OSB | 15 | 12.7 | TLF-95-113a | 51 | IIF-95-040 | 45 |
| OSB | 15 | 15.9 | Mean Ref | 52 | Mean Ref | 46 |
| OSB | 19 | 15.9 | TLF-95-127a | 52 | IIF-95-045 | 46 |
| Plywood | 15 | 15.9 | TLF-95-133a | 50 | IIF-95-048 | 43 |
| Plywood | 25 | 15.9 | TLF-96-061a | 52 | IIF-96-018 | 44 |

[1] 7.4 kg/m$^2$ (1.5 lb/sq.ft)

**(b) Single layer subfloor and double layer ceiling**



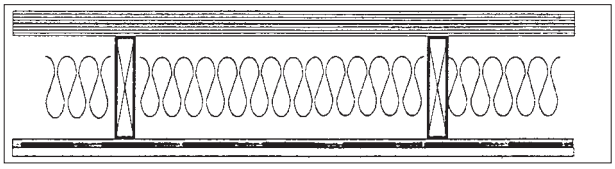
| Subfloor material | Subfloor thickness, mm | Gypsum board thickness, mm | Test ID | STC | Test ID | IIC |
|---|---|---|---|---|---|---|
| OSB | 15 | 2*12.7[1] | TLF-95-157a | 54 | IIF-95-060 | 48 |
| OSB | 15 | 2*12.7 | TLF-95-115a | 56 | IIF-95-041 | 50 |
| OSB | 15 | 2*15.9 | TLF-95-107a | 55 | IIF-95-039 | 49 |
| Plywood | 15 | 2*15.9 | TLF-95-145a | 55 | IIF-95-054 | 49 |
| Plywood | 25 | 2*15.9 | TLF-96-065a | 56 | IIF-96-020 | 48 |

[1] 7.4 kg/m$^2$ (1.5 lb/sq.ft)

## Table 2 Solid Wood Joists—Double layer subfloors and one or two ceiling layers

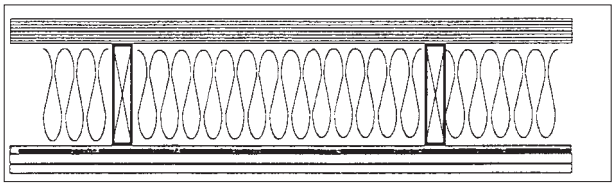
| | |
|---|---|
| Joist Depth | 235 mm |
| Joist Spacing | 406 mm o.c. |
| Cavity filling | 152 mm glass fiber batts |
| Resilient channels | 610 mm o.c. |

**(c) Double layer subfloor and single layer ceiling**



| Subfloor material | Subfloor thickness, mm | Gypsum board thickness, mm | Test ID | STC | Test ID | IIC |
|---|---|---|---|---|---|---|
| OSB | 2*15 | 15.9 | TLF-95-123a | 55 | IIF-95-043 | 47 |
| Plywood | 2*13 | 15.9 | TLF-95-129a | 51 | IIF-95-046 | 46 |
| Plywood | 2*15 | 15.9 | TLF-95-149a | 53 | IIF-95-056 | 46 |

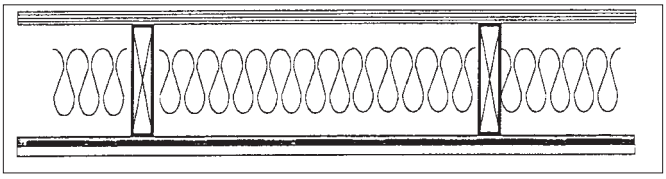
**(d) Double layer subfloor and double layer ceiling**



| Subfloor material | Subfloor thickness, mm | Gypsum board thickness, mm | Test ID | STC | Test ID | IIC |
|---|---|---|---|---|---|---|
| Plywood | 2*13 | 2*15.9 | TLF-95-131a | 58 | IIF-95-047 | 53 |
| Plywood | 2*15 | 2*15.9 | TLF-95-147a | 58 | IIF-95-055 | 51 |
| OSB | 2*15 | 2*15.9 | TLF-95-125a | 60 | IIF-95-044 | 53 |

## Table 3 Solid Wood Joists—Varying depth and spacing of joists

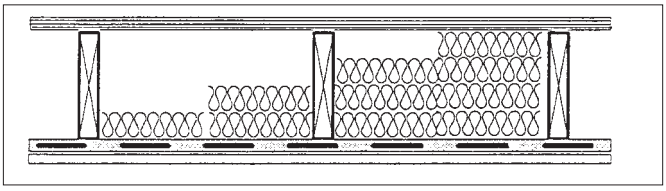
| | |
|---|---|
| Subfloor | 15 & 19 mm OSB |
| Cavity filling | 152 mm glass fiber batts |
| Resilient metal channels | 610 mm o.c. |
| Ceiling | 1 layer 15.9 mm gypsum board |



| **Joist Depth, mm** | **Joist Spacing, mm** | **OSB thickness, mm** | **Test ID** | **STC** | **Test ID** | **IIC** |
|---|---|---|---|---|---|---|
| 184 | 406 | 15 | TLF-95-159a | 50 | IIF-95-061 | 44 |
| 235 | 300 | 15 | TLF-96-031a | 50 | IIF-96-007 | 44 |
| 235 | 406 | 15 | Mean Ref | 52 | Mean Ref | 46 |
| 235 | 500 | 15 | TLF-96-043a | 52 | IIF-96-013 | 46 |
| 235 | 610 | 15 | TLF-96-035a | 54 | IIF-96-009 | 46 |
| 235 | 610 | 19 | TLF-96-039a | 53 | IIF-96-011 | 46 |
| 286 | 406 | 15 | TLF-95-215a | 52 | IIF-95-075 | 46 |

## Table 4 Solid Wood Joists—Variable cavity fillings

| | |
|---|---|
| Joist Depth | 235 mm |
| Joist Spacing | 406 mm o.c. |
| Subfloor | 15 mm OSB |
| Resilient metal channels | 610 mm o.c. |
| Ceiling gypsum board | 1 layer 15.9 mm |

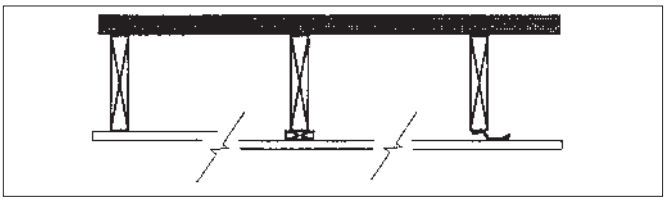


| **Cavity Filling** | | | | | |
|---|---|---|---|---|---|
| **Type**[1] | **Thickness** | **Test ID** | **STC** | **Test ID** | **IIC** |
| None | Empty | TLF-96-063a | 43 | IIF-96-019 | 37 |
| GFB | 65 | TLF-95-063a | 50 | IIF-95-019 | 45 |
| GFB | 90 | TLF-95-085a | 51 | IIF-95-030 | 45 |
| GFB | 152 | Mean ref | 52 | Mean ref | 46 |
| GFB | 202 | TLF-95-089a | 53 | IIF-95-032 | 46 |
| GFB | 217 | TLF-95-061a | 53 | IIF-95-018 | 46 |
| GFB | 270 | TLF-96-059a | 53 | IIF-96-017 | 46 |
| RFB | 90 | TLF-95-065a | 51 | IIF-95-020 | 46 |
| RFB | 210 | TLF-95-067a | 54 | IIF-95-021 | 48 |
| CFS | 59 | TLF-95-143a | 49 | IIF-95-053 | 42 |
| CFS | 90 | TLF-96-033a | 52 | IIF-96-008 | 45 |

[1] GFB=glass fiber batts, RFB=rock fiber batts, CFS=sprayed on cellulose fiber.

## Table 5 Solid Wood Joists—Variable ceiling supports, empty cavity

| | |
|---|---|
| Joist Depth | 235 mm |
| Joist Spacing | 406 mm o.c. |
| Subfloor | 15 mm OSB |
| Cavity filling | None |
| Ceiling gypsum board | 1 layer 15.9 mm |

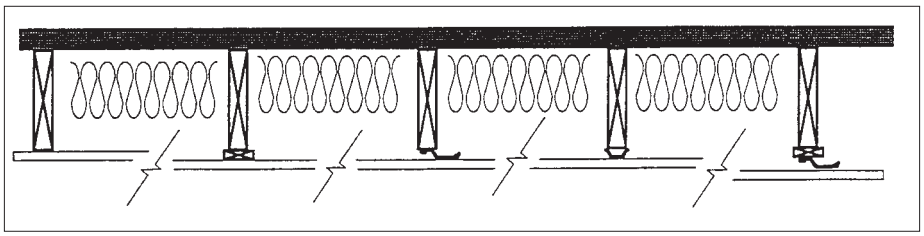


| Furring type[1] | Test ID | STC | Test ID | IIC |
|---|---|---|---|---|
| None | TLF-95-095a | 33 | IIF-95-035 | 28 |
| RC 610 mm o.c. | TLF-96-063a | 43 | IIF-96-019 | 37 |
| WF 610 mm o.c. | TLF-95-097a | 39 | IIF-95-036 | 32 |

[1] RC=13 mm resilient metal channels, WF=19 x 64 mm wood furring

## Table 6 Solid Wood Joists—Variable ceiling supports, absorption in cavity

| | |
|---|---|
| Joist Depth | 235 mm |
| Joist Spacing | 406 mm o.c. |
| Subfloor | 15 mm OSB |
| Cavity filling | 152 mm glass fiber batts |
| Ceiling gypsum board | 1 layer 15.9 mm |

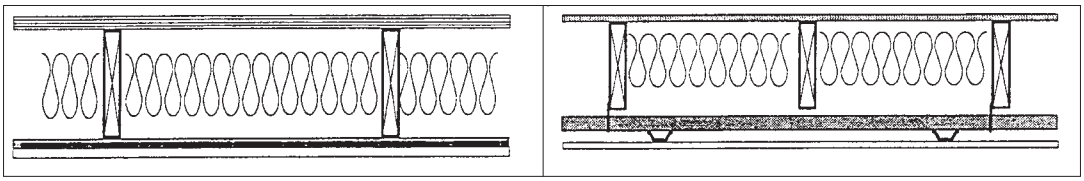


| Furring type[1] | Test ID | STC | Test ID | IIC |
|---|---|---|---|---|
| none | TLF-95-073a | 34 | IIF-95-024 | 30 |
| RC 200 mm o.c. | TLF-95-077a | 47 | IIF-95-026 | 40 |
| RC 300 mm o.c. | TLF-95-079a | 49 | IIF-95-027 | 42 |
| RC 406 mm o.c. | TLF-95-075a | 50 | IIF-95-025 | 42 |
| RC 610 mm o.c. | Mean ref | 52 | Mean ref | 46 |
| UC 610 mm o.c. | TLF-95-081a | 43 | IIF-95-028 | 36 |
| WF 610 mm o.c. | TLF-95-083a | 42 | IIF-95-029 | 35 |
| WF 610 mm o.c. and RC 610 mm o.c. | TLF-95-087a | 52 | IIF-95-031 | 45 |
| WF 610 mm o.c. and RC 610 mm o.c., no cross-bracing | TLF-95-091a | 52 | IIF-95-033 | 45 |

[1] RC=13 mm resilient metal channels, UC=22 mm deep U-channels, WF=19 x 64 mm wood furring

## Table 7 Solid Wood Joists—Alternative ceiling support

| | |
|---|---|
| Joist Spacing | 406 mm o.c. |
| Subfloor | 15 mm OSB |
| Cavity filling | 152 mm glass fiber batts |
| Ceiling gypsum board | 1 layer 15.9 mm |

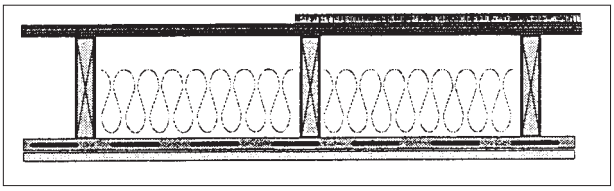


Note: The cavity depth is approximately the same in these two cases.

| Joist depth, mm | Ceiling support | Test ID | STC | Test ID | IIC |
|---|---|---|---|---|---|
| 286 | Resilient metal channels, 610 mm o.c. | TLF-95-215a | 52 | IIF-95-075 | 46 |
| 235 | Wire, C- and U-channels | TLF-96-089a | 54 | IIF-96-038 | 49 |

## Table 8 Solid Wood Joists—Different floor coverings

| | |
|---|---|
| Joist Depth | 235 mm |
| Joist Spacing | 406 mm o.c. |
| Subfloor | 15 mm OSB |
| Cavity filling | 152 mm glass fiber batts |
| Resilient Metal Channels | 610 mm o.c. |
| Ceiling gypsum board | 1 layer 15.9 mm |

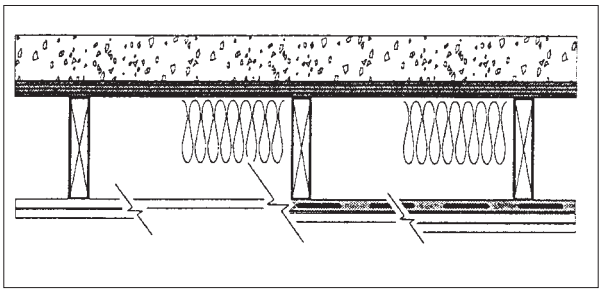


| **Covering** | **Test ID** | **STC** | **Test ID** | **IIC** |
|---|---|---|---|---|
| None | Mean Ref | 52 | Mean Ref | 46 |
| Carpet and 9 mm foam underpad | TLF-96-057a | 53 | IIF-96-016 | 67 |
| 1.2 mm vinyl, inexpensive | No Test | | IIF-96-029 | 44 |
| 1.9 mm vinyl, expensive | No Test | | IIF-96-030 | 45 |
| 1.2 mm vinyl, medium priced | No Test | | IIF-96-031 | 45 |

Note that the vinyl layers were glued to the floor but tests with the vinyl stapled to the floor give the same IIC ratings although there were significant differences between the two methods of installation at frequencies around 2500 Hz.

## Table 9 Solid Wood Joists—35 mm thick concrete topping with varying ceilings and cavity fillings

| | |
|---|---|
| Joist Depth | 235 mm |
| Joist Spacing | 406 mm o.c. |
| Subfloor | 15 mm OSB |
| Cavity filling | 152 mm glass fiber batts |



**(a) Pre-poured, reinforced 35 mm concrete slab placed on top of OSB**

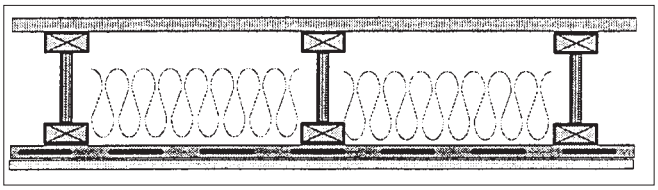
| Gypsum Board Thickness, mm | Resilient Channels | Cavity Filling | Test ID | STC | Test ID | IIC |
|---|---|---|---|---|---|---|
| 15.9 | None | 152 mm glass fiber batts | TLF-96-111a | 48 | IIF-96-049 | 35 |
| 15.9 | 610 mm o.c. | 152 mm glass fiber batts | TLF-96-107a | 68 | IIF-96-047 | 48 |

**(b) 35 mm concrete poured directly on the the OSB sub-floor and allowed to set**

| Gypsum Board Thickness, mm | Resilient Channels | Cavity Filling | Test ID | STC | Test ID | IIC |
|---|---|---|---|---|---|---|
| 15.9 | None | 152 mm glass fiber batts | TLF-96-139a | 48 | IIF-96-061 | 28 |
| 15.9 | 610 mm o.c. | 152 mm glass fiber batts | TLF-96-143a | 67 | IIF-96-063 | 40 |
| 2*15.9 | 610 mm o.c. | 152 mm glass fiber batts | TLF-96-147a | 70 | IIF-96-065 | 46 |
| 15.9 | 610 mm o.c. | None | TLF-96-151a | 61 | IIF-96-067 | 32 |
| 2*15.9 | 610 mm o.c. | None | TLF-96-155a | 65 | IIF-96-068 | 38 |
| 15.9 | None | None | TLF-96-157a | 46 | IIF-96-069 | 25 |
| 2*15.9 | None | None | TLF-96-161a | 47 | IIF-96-071 | 30 |

## Table 10 Wood I-Joists—Different manufacturers

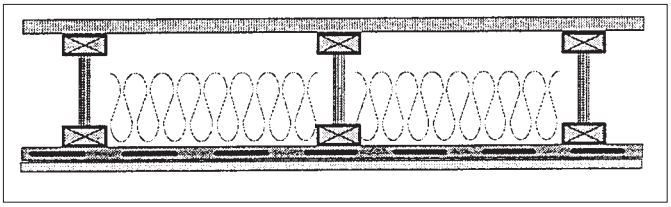
| | |
|---|---|
| Joist Depth | 241 mm |
| Joist Spacing | 406 mm o.c. |
| Subfloor | 15 mm OSB |
| Cavity filling | 152 mm glass fiber batts |
| Resilient metal channels | 610 mm o.c. |
| Ceiling gypsum board | 1 layer 15.9 mm |



| | Flange dimensions, mm | | | | | |
|---|---|---|---|---|---|---|
| **Manufacturer** | **Horizontal** | **Vertical** | **Test ID** | **STC** | **Test ID** | **IIC** |
| A | 64 | 38 | TLF-96-069a | 51 | IIF-96-022 | 45 |
| A | 38 | 64 | TLF-96-071a | 51 | IIF-96-023 | 46 |
| A | 89 | 38 | TLF-96-073a | 52 | IIF-96-024 | 45 |
| B | 38 | 38 | TLF-96-127a | 52 | IIF-96-055 | 45 |
| B | 57 | 38 | TLF-96-131a | 53 | IIF-96-057 | 46 |
| C | 38 | 38 | TLF-96-159a | 50 | IIF-96-070 | 44 |
| D | 38 | 38 | TLF-97-007a | 48 | IIF-97-004 | 42 |
| E | 64 | 38 | TLF-97-029a | 48 | IIF-97-015 | 42 |

## Table 11 Wood I-Joists—89 wide x 38 mm thick flanges, different joist depths

| | |
|---|---|
| Joist Spacing | 406 mm o.c. |
| Subfloor | 15 mm OSB |
| Cavity filling | 152 mm glass fiber batts |
| Resilient metal channels | 610 mm o.c. |
| Ceiling gypsum board | 1 layer 15.9 mm |

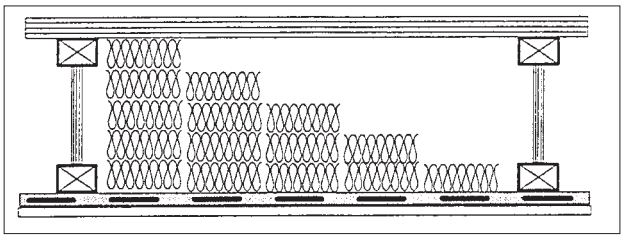


| Joist Depth, mm | Test ID | STC | Test ID | IIC |
|---|---|---|---|---|
| 241 | TLF-96-073a | 52 | IIF-96-024 | 45 |
| 355 | TLF-96-075a | 53 | IIF-96-028 | 45 |
| 457[1] | TLF-96-077a | 53 | IIF-96-032 | 46 |
| 457 | TLF-96-101a | 53 | IIF-96-044 | 47 |

[1] 15 mm Waferboard, not OSB

## Table 12 Wood I-Joists—Variable cavity filling

| | |
|---|---|
| Joist Depth | 457 mm |
| Joist Spacing | 406 mm o.c. |
| Subfloor | 15 mm OSB |
| Resilient metal channels | 610 mm o.c. |
| Ceiling gypsum board | 1 layer 15.9 mm |

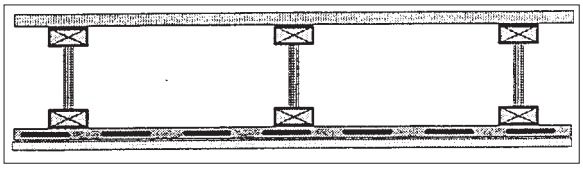


| Material[1] | Thickness | Test ID | STC | Test ID | IIC |
|---|---|---|---|---|---|
| GFB | 90 | TLF-96-105a | 52 | IIF-96-046 | 46 |
| GFB | 152 | TLF-96-101a | 53 | IIF-96-044 | 47 |
| GFB | 180 | TLF-96-109a | 54 | IIF-96-048 | 47 |
| GFB | 292 | TLF-96-113a | 55 | IIF-96-050 | 48 |
| GFB | 354 | TLF-96-115a | 56 | IIF-96-051 | 49 |
| GFB | 456 | TLF-96-117a | 57 | IIF-96-052 | 49 |
| RFB | 90 | TLF-96-119a | 53 | IIF-96-053 | 47 |
| RFB | 456 | TLF-96-121a | 59 | IIF-96-054 | 51 |

[1] GFB=glass fiber batts, RFB=rock fiber batts.

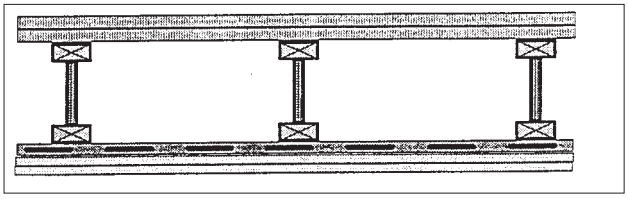
## Table 13 241 mm deep Wood I-Joists, 89 wide x 38 mm high flanges, empty cavity—Variable joist spacing, subfloors, ceilings and resilient metal channel spacings

**(a) Single layer of 15 mm OSB, single layer of 12.7 mm gypsum board**



| I-joist spacing, mm | Resilient channel spacing, mm | Test ID | STC | Test ID | IIC |
|---|---|---|---|---|---|
| 406 | 610 | TLF-96-165a | 43 | IIF-96-073 | 36 |
| 406 | 406 | TLF-96-193a | 42 | IIF-96-085 | 36 |
| 610 (10 joists) | 406 | TLF-96-201a | 44 | IIF-96-089 | 35 |

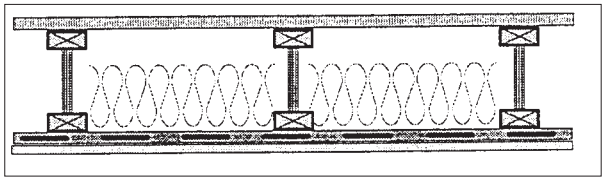
**(b) Double layer of 15 mm OSB, double layer of gypsum board**



| | | | | | |
|---|---|---|---|---|---|
| **double layer of 12.7 mm gypsum board** | | | | | |
| 406 | 406 | TLF-96-187a | 51 | IIF-96-082 | 43 |
| 406 | 610 | TLF-96-177a | 51 | IIF-96-079 | 41 |
| 610 (10 joists) | 406 | TLF-97-001a | 53 | IIF-97-001 | 44 |
| **double layer of 15.9 mm gypsum board** | | | | | |
| 406 | 406 | TLF-96-197a | 49 | IIF-96-087 | 41 |
| 406 | 610 | TLF-96-181a | 51 | IIF-96-081 | 45 |
| 610 (10 joists) | 406 | TLF-97-005a | 53 | IIF-97-003 | 45 |

## Table 14 Wood I-Joists—Different resilient metal channel (RC) spacing

| | |
|---|---|
| Joist Depth | 241 mm |
| Joist Spacing | 406 mm o.c. |
| Subfloor | 15 mm OSB |
| Cavity filling | 152 mm glass fiber batts |
| Ceiling gypsum board | 1 layer 15.9 mm |

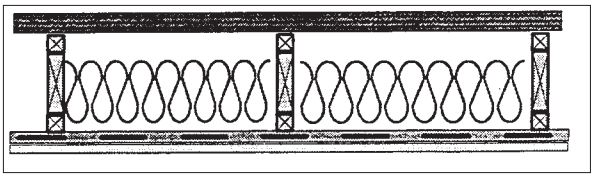


| **Resilient channel spacing** | **Test ID** | **STC** | **Test ID** | **IIC** |
|---|---|---|---|---|
| 406 mm | TLF-97-003a | 50 | IIF-97-002 | 44 |
| 610 mm | TLF-97-007a | 48 | IIF-97-004 | 42 |

## Table 15 Wood Truss Floors—Varying joist depth and spacing and varying subfloor

| | |
|---|---|
| Cavity filling | 152 mm glass fiber batts |
| Resilient metal channels | 610 mm o.c. |
| Ceiling gypsum board | 1 layer 15.9 mm |

**Trusses constructed from 38 x 89 mm lumber with largest dimension vertical**

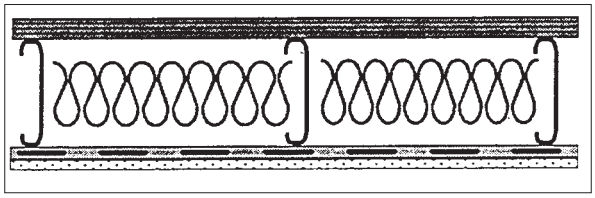


| OSB thickness | Truss depth | Truss spacing | Test ID | STC | Test ID | IIC |
|---|---|---|---|---|---|---|
| 15 | 356 | 406 | TLF-97-033a | 54 | IIF-97-017 | 42 |
| 15 | 356 | 488 | TLF-97-039a | 52 | IIF-97-019 | 41 |
| 15 | 356 | 610 | TLF-97-045a | 54 | IIF-97-022 | 42 |
| 15 | 457 | 488 | TLF-97-041a | 55 | IIF-97-020 | 44 |
| 15 | 457 | 610 | TLF-97-043a | 53 | IIF-97-021 | 42 |
| 19 | 356 | 610 | TLF-97-047a | 54 | IIF-97-023 | 42 |
| 19 | 356[1] | 610 | TLF-97-053a | 55 | IIF-97-026 | 43 |
| 19 | 457 | 610 | TLF-97-049a | 53 | IIF-97-024 | 42 |
| 19 | 610 | 610 | TLF-97-051a | 55 | IIF-97-025 | 43 |

[1] Truss formed from 38 x 64 mm lumber with largest dimension horizontal

## Table 16 Steel Joist Floors—Varying joist depth, spacing and metal gauge, varying subfloor

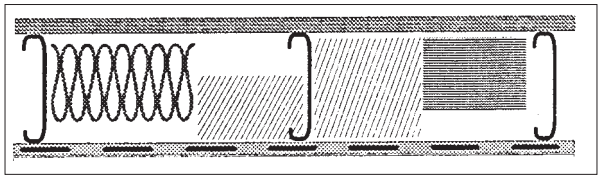
| | |
|---|---|
| Cavity filling | 152 mm glass fiber batts |
| Resilient Metal Channels | 610 mm o.c. |
| Ceiling gypsum board | 1 layer 15.9 mm |



| Steel Gauge | Joist Depth | Joist Spacing | OSB Thickness | Test ID | STC | Test ID | IIC |
|---|---|---|---|---|---|---|---|
| 14 | 203 | 406 | 16 mm OSB | TLF-97-057a | 52 | IIF-97-028 | 45 |
| 16 | 203 | 406 | 16 mm OSB | TLF-97-059a | 51 | IIF-97-029 | 45 |
| 18 | 203 | 406 | 16 mm OSB | TLF-97-061a | 50 | IIF-97-030 | 44 |
| 16 | 203 | 610 | 16 mm OSB | TLF-97-063a | 53 | IIF-97-031 | 44 |
| 16 | 254 | 406 | 16 mm OSB | TLF-97-065a | 51 | IIF-97-032 | 44 |
| 16 | 305 | 406 | 16 mm OSB | TLF-97-069a | 52 | IIF-97-034 | 44 |
| 16 | 203 | 610 | 19 mm OSB | TLF-97-067a | 53 | IIF-97-033 | 44 |

## Table 17 Steel Joists, 16 gauge—Varying cavity absorption

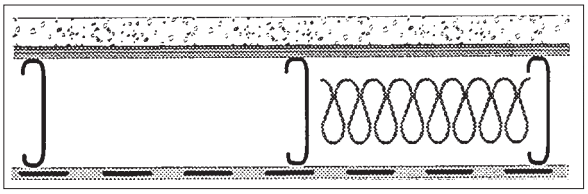
| | |
|---|---|
| Subfloor | 15 mm OSB |
| Joist Depth | 203 mm |
| Joist Spacing | 406 mm |
| Resilient Metal Channels | 610 mm o.c. |
| Ceiling gypsum board | 1 layer 15.9 mm |



| Cavity filling | Test ID | STC | Test ID | IIC |
|---|---|---|---|---|
| none | TLF-98-009a | 44 | IIF-98-004 | 35 |
| 152 mm glass fiber batts | TLF-98-001a | 50 | IIF-98-001 | 43 |
| 140 mm rock fiber batts | TLF-98-005a | 51 | IIF-98-002 | 45 |
| 90 mm Cellulose fiber | TLF-98-011a | 51 | IIF-98-005 | 44 |
| 140 mm Cellulose fiber | TLF-98-013a | 52 | IIF-98-006 | 45 |

## Table 18 Steel Joists, 16 gauge—Gypsum concrete topping

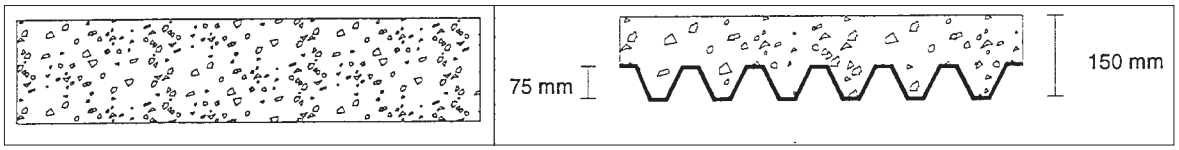
**25 mm Gypsum concrete topping on 15 mm OSB, 16 gauge joists**



| | |
|---|---|
| Subfloor | 15 mm OSB |
| Joist Depth | 203 mm |
| Joist Spacing | 406 mm |
| Resilient Metal Channels | 610 mm o.c. |
| Ceiling gypsum board | 1 layer 15.9 mm |

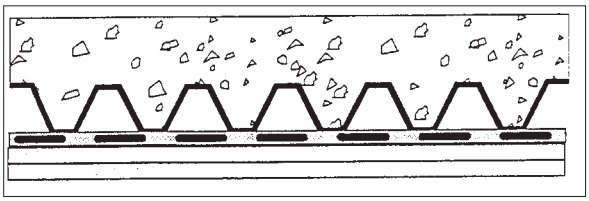
| Cavity filling | Test ID | STC | Test ID | IIC |
|---|---|---|---|---|
| None | TLF-97-079a | 55 | IIF-97-039 | 24 |
| 152 mm glass fiber batts | TLF-97-081a | 60 | IIF-97-040 | 28 |

## Table 19 Concrete Floors—Uniform and ribbed slabs




| Slab Thickness | Test ID | STC | Test ID | IIC |
|---|---|---|---|---|
| 145 mm | TLF-95-025a | 53 | IIF-95-004 | 27 |
| 95 mm | TLF-98-007a | 47 | IIF-95-003 | 20 |
| Ribbed 75 - 150 mm | TLF-97-101a | 51 | IIF-97-045 | 21 |

**Ribbed concrete slab with two layers of 12.7 mm gypsum board suspended from Resilient metal channels spaced 406 mm o.c.**



| Thickness | Test ID | STC | Test ID | IIC |
|---|---|---|---|---|
| Ribbed 75 - 150 mm | TLF-97-109a | 57 | IIF-97-049 | 36 |

## Table 20 Ceiling Layers Only

| | |
|---|---|
| Joist Depth | 235 mm, solid wood |
| Joist Spacing | 406 mm o.c. |
| Ceiling support | Resilient metal channels |

| Ceiling | Test ID | STC |
|---|---|---|
| 1 sheet of 15.9 mm gypsum board | TLF-95-103a | 29 |
| 2 sheets of 15.9 mm gypsum board | TLF-95-105a | 35 |
| 1 sheet of 12.7 mm gypsum board | TLF-95-119a | 29 |
| 2 sheets of 12.7 mm gypsum board | TLF-95-117a | 33 |
| 1 sheet of light[1] 12.7 mm gypsum board | TLF-96-183a | 27 |
| 2 sheets of light[1] 12.7 mm gypsum board | TLF-96-185a | 32 |

[1] 7.4 kg/m$^2$ (1.5 lb/sq. ft.)

## Table 21 Floor Layers Only

**Solid 38 x 235 mm wood joists, 406 mm o.c.**

| Subfloor | Test ID | STC | Test ID | IIC |
|---|---|---|---|---|
| 15 mm OSB[1] | TLF-95-101a | 24 | IIF-95-038 | 20 |
| 16 mm plywood | TLF-96-137a | 22 | IIF-96-060 | 18 |
| 2 sheets of 16 mm plywood | TLF-96-141a | 26 | IIF-96-062 | 22 |
| 13 mm plywood | TLF-96-145a | 22 | IIF-96-064 | 20 |
| 2 sheets of 13 mm plywood | TLF-96-149a | 26 | IIF-96-066 | 22 |
| 25 mm plywood | TLF-96-067a | 22 | IIF-96-021 | 14 |
| 35 mm normal weight concrete on 15 mm OSB | TLF-96-163a | 41 | IIF-96-072 | 15 |

[1] Caulking and taping the joints between the sheets of OSB had no effect on the sound insulation.

**Solid 38 x 235 mm wood joists, 610 mm o.c.**

| Subfloor | Test ID | STC | Test ID | IIC |
|---|---|---|---|---|
| 15 mm OSB | TLF-96-037a | 25 | IIF-96-010 | 19 |
| 19 mm OSB | TLF-96-041a | 24 | IIF-96-012 | 18 |

**Wood I-joists, 457 mm deep, 406 mm o.c.**

| Subfloor | Test ID | STC | Test ID | IIC |
|---|---|---|---|---|
| 15 mm OSB | TLF-96-081a | 25 | IIF-96-034 | 20 |
| 15 mm OSB | TLF-96-097a | 25 | IIF-96-042 | 21 |

**Wood I-joists, 241 mm deep, 406 mm o.c.**

| Subfloor | Test ID | STC | Test ID | IIC |
|---|---|---|---|---|
| 15 mm OSB | TLF-97-009a | 24 | 97-005 | 18 |

**CMHC Project Manager:** Jacques Rousseau

Research Consultants: A.C.C. Warnock and J.A. Birta, National Research Council Canada

**Housing Research at CMHC**

Under Part IX of the *National Housing Act*, the Government of Canada provides funds to CMHC to conduct research into the social, economic and technical aspects of housing and related fields, and to undertake the publishing and distribution of the results of this research.

This fact sheet is one of a series intended to inform you of the nature and scope of CMHC's research.

This **Research Highlights** fact sheet is one of a wide variety of housing-related publications produced by CMHC.

For a complete list of **Research Highlights**, or for more information on CMHC housing research and information, please contact:

The Canadian Housing Information Centre
Canada Mortgage and Housing Corporation
700 Montreal Road
Ottawa, ON K1A 0P7

Telephone: 1 800 668-2642
Fax: 1 800 245-9274

**OUR WEB SITE ADDRESS:** www.cmhc-schl.gc.ca