Research & Development Highlights

Technical Series
90-247

Soundproofing Floors
Phase II: The Surface of the Floor

In response to concerns about excessive noise transmission between units in multiple-unit housing, Canada Mortgage and Housing Corporation (CMHC) commissioned two studies to determine the performance of floor/ceiling assemblies separating units in wood-frame buildings.

The first study looked at improving the sound performance of floor/ceiling assemblies by adding various elements to the underside of the assemblies. The second study, described here, focused on the performance of various floor coverings, such as carpets, concrete, additional plywood, fibre board, and so on.

Objectives

The following criteria were used to determine whether the floor/ceiling structures tested would be acceptable and useful to architects and builders:

- the cost must be reasonable;
- the difference in elevation resulting from a floor surface change (e.g. carpet to ceramic tile) must be minimal (20 mm maximum); and
- the sound transmission and impact isolation must meet the expectations of the majority of the occupants. Sound Transmission Class (STC) 55 and Impact Isolation Class (IIC) 55 were considered acceptable results. (Higher STC or JIC ratings indicate lower sound or impact transmission and are therefore more desirable.)

Tests were conducted on 22 different floor treatments. In order to assure continuity between the two studies, a basic floor was selected from the first phase tests. This floor! ceiling assembly was chosen because it provided good STC and IIC ratings. The basic floor! ceiling construction comprised:

- 16 mm plywood,
- 38 mm x 235 mm wood joists at 400 mm centres,
- 13 mm resilient metal furring at 600 mm centres,
- three layers of fibreglass insulation in the cavity, and
- two layers of 16 mm gypsum board.

Results

Eleven of the assemblies tested (floors 5,6,7,8,9, 16, 17, 18, 19,20 and 21) met the objectives of the study.

The results of the measurements and the construction of different floor/ceiling assemblies are summarized and described in the following table. The airborne sound isolation increases with floor surface mass (i.e. at about 6 dE per double surface mass). The impact sound isolation cannot be related to the surface mass.

Carpet with a separate foam underpad provides excellent impact isolation. If an additional 10 kg/in^2 surface mass is inserted between the carpet and the basic floor/ceiling, STC 60 and IIC 60 will be achieved.

An additional layer of plywood attached to the basic floor/ceiling increases the STC due to the added mass. It also increases the high frequency JIC, probably due to the additional internal damping. The addition of building paper between the plywood layers is ineffective.

When a layer of fibreboard was inserted between the plywood layers, the STC increased (due to the added mass) and the IIC increased, mainly due to the fact that the fibreboard was floating on the basic floor/ceiling.

A 19 mm concrete layer was used in several tests. This laminate of two layers of 6 mm prefabricated concrete board (Wonderboard) cemented together with a 6 mm cement slurry mortar served two purposes:

(i) it allowed the evaluation of the effect of significant added mass; and

(ii) it simulated a hard-finish floor surface (e.g., marble, ceramic tile.).

When the finished floor is not carpet, it is necessary to provide a floating floor to achieve high impact isolation (IIC 55 or more).

Furred floating floors are acoustically similar to unfurred floating floors. However, unfurred floors are preferable since the floor thickness is reduced.

During construction, care must be taken to ensure that resilient layers are not short-circuited with nails, screws, concrete, and so on. This applies to both the ceiling and

NHA 6330

floor. Perimeter details must allow movement, yet be air-tight.

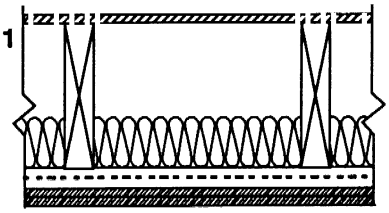
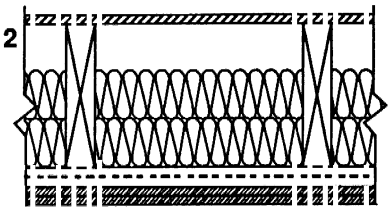
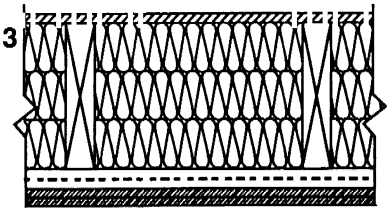
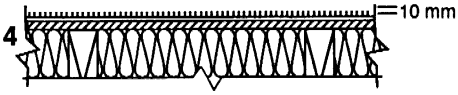
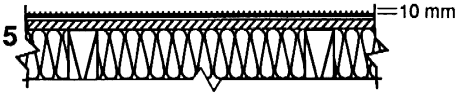
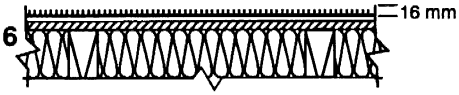
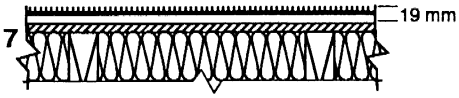
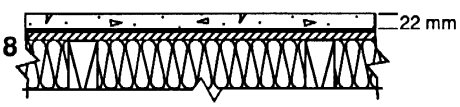
Conclusions

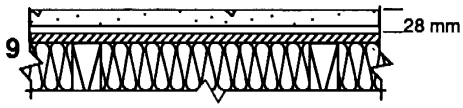
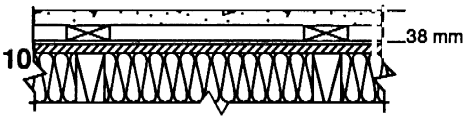
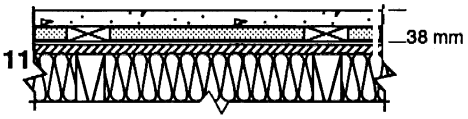
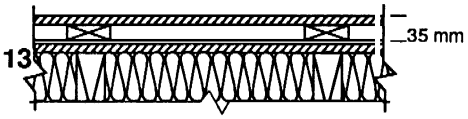
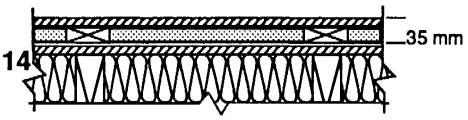
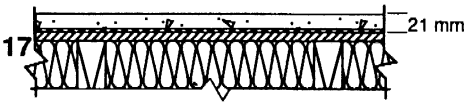
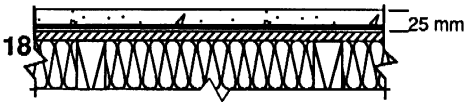
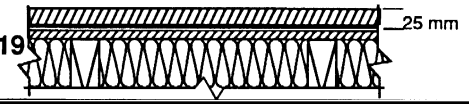
When carpets are used, a carpet underlay should be installed (see floors 5,6 and 7).

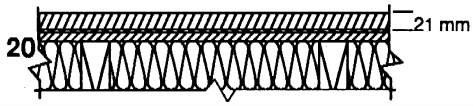
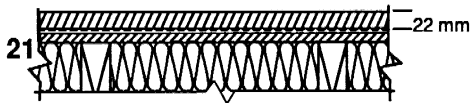
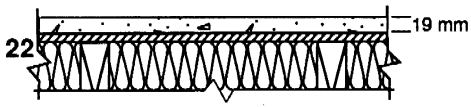
When hardwood or vinyl is used as floor covering, the construction should be similar to floors 19 or 20.

When marble, ceramic tile, and so on are used, floors should be constructed in the same way as floors 9, 17, 18, **19 and 20.**

See also: Soundproofing Floors—Phase I: The Underside of the Floor (90-246).

	Composition	Sound Transmission Class	impaci Insulation Class
1 	•l6mmplywood • 38 mm x 230 mm joists at 400 mm centres • 1 layer 90 mm glass fibre baft insulation • 13 mm resilient furring at 600 mm centres • 2 mm x 16 mm gypsum board	52	48
2 	• same as floor 1, except that two layers of 90 mm glass fibre insulation are used	52	48
3 	• same as fbor 1, except that three layers of 90 mm glass fibre insulation are used This is the basic floor/Ceiling that forms part of floors 4 through 22	51	49
4 	• 10 mm carpet • basic floor/ceiling	54	63
5 	• carpet with integral foam backing (5 mm pile, 5 mm foam) • basic floor/ceiling	55	65
6 	• 10mm carpet • 6 mm felt underpad • basic floor/ceiling	56	69
7 	• 10mm carpet • 9 mm foam underpad • basic floor/ceiling	55	81
8 	• 19 mm concrete • 3 mm foam rubber • basic floor/ceiling	62	56

	Composition	Sound Transmission Class	Impact Insulation Class
	•l9mmconcrete • 9 mm foam underpad • basic floor/ceiling	62	59
	•l9mmconcrete • 16 x 70 mm wood furring at 400 mm centres • 3 x 70 mm foam rubber under furring • basic floor/ceiling	61	57
	• same as floor 10, except for use of glass fibre between furring strips	61	59
	•l6mmplywood • basic floor/ceiling	58	53
	•l6mmplywood • 16 x 70 mm furring at 400 mm centres • 3 x 70 mm foam rubber under furring • basic floor/ceiling	58	54
	• same as floor 13, except for use of glass fibre between furring strips	60	57
	•l6mmplywood • 1 mm building paper • basic floor/ceiling	58	52
	•l6mmplywood • 12 mm fibre board • basic floor/ceiling	61	57
	•l9mmconcrete • 2 mm geotextile • basic floor/ceiling	62	58
	•l9mmconcrote • 6 mm felt underpad • basic floor/ceiling	63	59
	•l9mmplywood • 6 mm felt underpad • basic floor/ceiling	60	56

	Composition	Sound Transmission Class	Impact Insulation Class
	•l9mmplywood • 2 mm geotextile • basic floor/ceiling	60	55
	• 19mm plywood • 3 mm foam rubber • basic floor/ceiling	59	55
	• 19 mm concrete • basic floor/ceiling	62	53

Project Manager: Jacques Rousseau

Research Report: Sound Performance of Wood Floor/Ceiling Assemblies (Phase II)

Research Consultant: MJM Acoustical Consultants Inc.

A full report on this research prolect is available from the Canadian Housing Information Centre at the address below.

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