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Field measurements of Vibrations in a wooden floor

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One of the main drawbacks of lightweight structures is related to the sound transmission. Complaints arise sometimes against this type of structures, related to the propagation of low frequency vibrations induced by human activities. Most problems are caused by human walking, more exactly foot impacts, which generate a harmonic force whose frequency is close to the natural frequency of the floor. This investigation is focused on measurements of different type of vibrations: vibration levels, induced walking vibrations with real human walking; those were performed on an in-situ wooden floor. The measurements of accelerations induced by a walking person were used to evaluate existing vibration criteria.

1 Introduction

In modern constructions, where cost and production time matter, lightweight solutions are getting more and more widely chosen over traditional heavy weight constructions methods. If structures made of timber material are cost effective and can be produced quickly, they also have some particularities that need to be taken into account. The differences in weight, density and stiffness compared to traditional materials are often the cause of more nuisances related to sound transmission. The main cause of the annoying vibrations in residential and office buildings is often human walking. Studies of the transmission properties of a wood cross junction and in-situ measurements of the vibrations caused by footsteps in an actual multi-storey construction build on a wooden lightweight frame has been presented previously in [1,2]. Arrays of accelerometers have been used to capture simultaneously the vibration levels, while several test persons were walking on the floor nearby. The idea of establishing a classification of the floor behaviour in terms of vibrations caused by human walking emanates from Toratti & Talja [3].

2 Description of the object under test

The work presented here takes place in Nordmaling, on the east coast south from Umeå. The figure 1 shows the measured building and the dwelling.

Figure 1: The building and measured dwelling.

3 Measurement setup

The investigated floors are situated in one of the apartments of the building, as shown in figure 2.

Figure 2: Measurement set-up on the floors.

Arrays of accelerometers were fixed tightly in place with screws on the floor that was investigated. The sensors were disposed along a line parallel to the walking direction,

4 Results

Several recordings have been done with different persons walking on the floor, men and women, and of different age and weight. From each recording, the signals have been analysed and the foot step impacts on the floor extracted and isolated. The accelerometer that has recorded the highest signal is retained and the corresponding data is further analysed. The third-octave frequency spectrum of the accelerometer signals has been extracted for the recorded signal from steps and the accelerometer with the highest signal has been retained for the final curve. Two example curves are represented on figure 3, corresponding to two measured floors, one with a woman walking, the second with a man walking. On each graphic plot, the curve defined in the ISO 2631-2:1989 standard has been plotted for reference. The presented curves show that the level of vibrations caused by the walking nearby the sensors is acceptable and will not cause too high nuisances to the inhabitants of the dwelling.

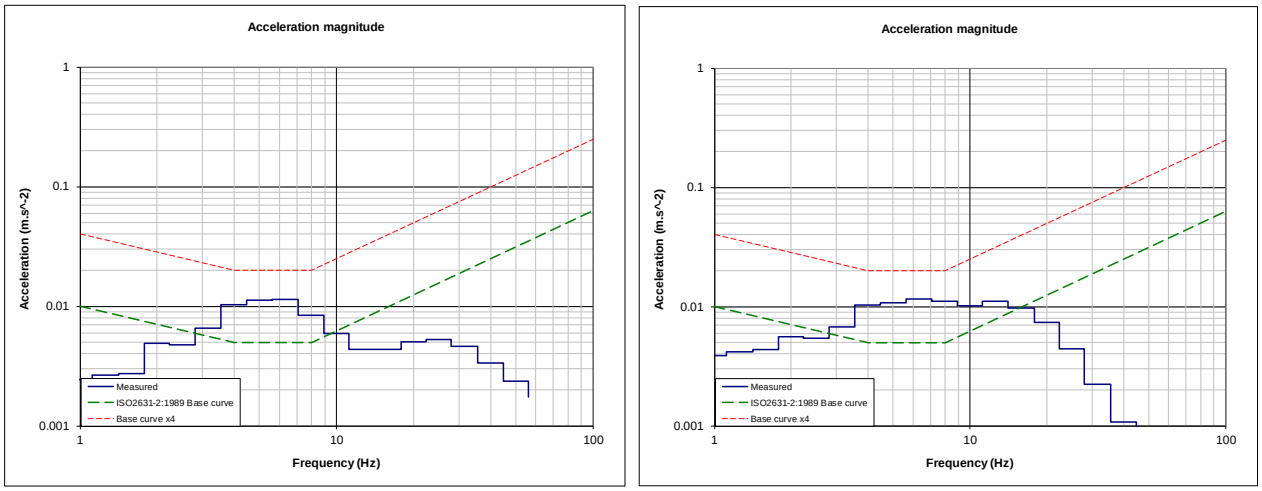

Figure 3: Measured response to foot step impacts for two different floors and for two persons, a female walker (left curve) and a male walker (right curve).

5 Conclusions

This paper presents results obtained from a measurement session in a newly built multi-storey construction based on a wooden lightweight frame. The use of arrays of accelerometer to record the vibration level induced by a person walking on a floor allows for a useful and accurate assessment of the intrinsic quality of the structure under investigation. This investigation method proves to be useful as a tool for evaluating the level of comfort that the inhabitants will experience when they will live in the finished apartment.

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