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INVESTIGATIONS ON IMPULSE MEASUREMENT METHODS FOR IMPACT SOUND INSULATION TESTING

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INTRODUCTION

Test methods for low frequency impact sound insulation are needed to supplement tests with the standard tapping machine in order to get more realistic judgements in particular of lightweight floors e.g. wood joist constructions. Extending the frequency range of the normal measurements seems not to be suitable to solve the problem. The use of a heavy impact source with impulsive force characteristics has been frequently proposed and is already incorporated in a Japanese standard [1]. Some aspects of applicability of such methods have been studied and will be discussed.

DEVELOPMENTS

An impact source has been developed which can work with automobile tires according to the Japanese standard or other impactors which drop down from heights which can be adjusted to more than 1 m. The floor surface is blown only once at one fall. Automatic triggering of an electronic signal storage device is provided. The microphone signal is sampled with a frequency up to 12 kHz, digitized with high resolution (up to 16 bit) and stored in a large memory (up to 25000 words). Transfer to a magnetic storage media is possible. In this way impulse sound signals can be repeated with high accuracy for different tests in the laboratory. The instrument is portable so that field measurements became feasible.

MEASUREMENTS

Different kinds of wood joist floors as well as concrete floors have been exited with an automobile tire impactor of about 7 kg mass with fall heights of 90 cm and 45 cm. An impulsive sound signal got 1 m below a wood joist floor is shown for example in Fig. 1. Analysis of the signals has been performed with a digital real time third-octave analyzer (B&K 2131) in the mode 'max. hold'. Different integration times have been applied to the repeatedly reproduced signals.

RESULTS

Impact source. The use of an once impacting automobile tire as a heavy impact sound source has been confirmed as a method of good feasibility in particular if only one or a few impacts are necessary in one source position. Provided that loading the impact generator is not to be done automatically relative simple constructions have been considered as suitable. The fall height of 90 cm according the Japanese standard specification has been found as too high as serious problems with strong vibrations in the receiving room sometimes occured. Reduced height of about 50 cm seems to be an adequate value.

Signal storage. Digital storage of the impulsive sound signal in the receiving room and analysing of the repeated reproduction of the signal has been ensured as an especially recommendable method. A signal of only 0.5 - 1 s duration is to be stored, a sampling frequency of 1 kHz would be adequate as the maximum frequency of interest would be 200 to 300 Hz.(It should be remembered that such a test method is provided only as an addition to tests with the standard tapping machine). If it is necessary the signal reproduction could be speeded up ten times in order to get frequency translation to a frequency range of normal impact sound measurement instruments. A model of a corresponding storage device has been proved as economic constructable.

Impact sound levels. Fig. 2 and Fig. 3 give examples of impact sound levels in third-octave bands measured in receiving rooms below very different floor constructions with an automobile tire fall from a height of 45 cm. Level detection has been done in the mode "max. hold" of the analyzer. Integration time 1/32 s which has been tested as most convenient from different points of view has been applied.

Old wood joist floors have been tested in German multifamily houses. With support of the Jutland Technological Institute also some new build and renewed wood joist floors have been incorporated in the study. Three very different concrete floors have been measured in the test facilities of PTB. This objects impact sound levels from normal tests with the standard tapping machine are given in Fig. 4.

The linear measured sound pressure levels of all wood joist floors tested with the tire fall from height of 45 cm appeared in the range of 107 to 114 dB and at the concrete floors at 87 to 91 dB. This levels give obvious wrong informations related to the impact sound insulation in the low audible frequency range. Also A-weighting seems not to be sufficient for differentiation of the insulation properties of the floors.

Third-octave analysis results in Fig. 2 and 3 show very different response to tire fall impact of the different floors. To determine a rating procedure further investigation including subjectiv test are obvious necessary.

It has been found that the repeatability of the impulse signal in the receiving room in a fixed microphone position is of a high degree (standard deviation about 0,5 dB in all frequency bands). But variations in distance of the microphone from the ceiling showed large level variations. Further studies in this field are intended.

REFERENCE

[1] S. Kimura, "Method for field measurement of floor impact sound level using heavy impact source", 10. Intern. Congr. of Acoustics, Sydney 1980, E-4.7.

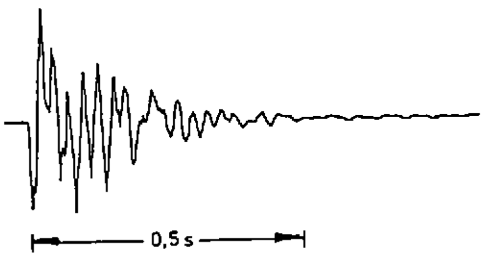

Fig. 1 Waveform of the impact sound signal in the receiving room measured 1 m below wood joist floor 2 (s.Fig.2) (tire fall impact)

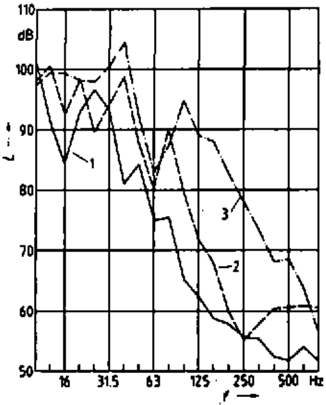

Fig. 2 Third-octave impact sound pressure levels in receiving rooms below different wood joist floors (tire fall impact)

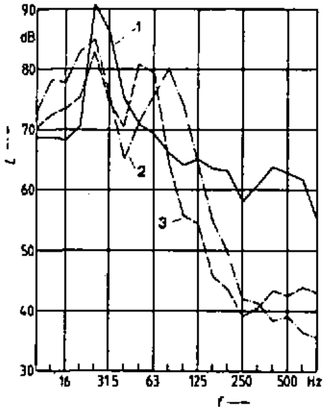

Fig. 3 Third-octave impact sound pressure levels in testrooms below different concrete floors (see Fig.4) (tire fall impacts)

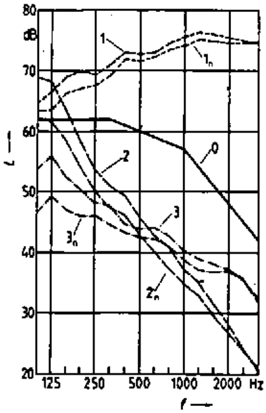

Fig. 4 Third-octave impact sound pressure levels in test rooms below different concrete floors (standard tapping machine)

curve 1,2,3:
levels of floor 1,2,3
1_n, 2_n, 3_n normalized impact sound pressure levels

0 reference curve

floor
1 bare concrete floor

2 floating gypsum fiberarmed plates on a concrete slab

3 floating concrete floor on a concrete slab.