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METHOD OF DETERMINATION OF SOUND ABSORPTION COEFFICIENT OF TIMBER BY STANDING WAVE METHOD

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METHOD OF DETERMINATION OF SOUND ABSORPTION COEFFICIENT OF TIMBER BY STANDING WAVE METHOD

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Indian Standard

METHOD OF DETERMINATION OF SOUND ABSORPTION COEFFICIENT OF TIMBER BY STANDING WAVE METHOD

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 24 December 1982, after the draft finalized by the Timber Sectional Committee had been approved by the Civil Engineering Division Council.

0.2 Wood is sometimes used for panelling and false ceiling for the purpose of reducing excessive reverberation and improving audibility. Hence to evaluate acoustical effectiveness of various species of timber sound absorption coefficient is required. In this standard the method of determination of sound absorption coefficient by standing wave method under normal incidence (generally called tube method) is specified.

0.3 Sometimes reverberation chamber method is preferred for the determination of sound absorption coefficient of acoustical material as field conditions can be closely simulated as regards the incidence of sound waves at random angles and method of mounting the specimens. Its disadvantages are that it is quite expensive, time consuming, involves elaborate test facilities and requires a large specimen. The tube method is a simple and rapid technique of determination of sound absorption coefficient.

0.4 In the formulation of this standard due weightage has been given to international co-ordination among the standards and practices prevailing in different countries in addition to relating it to the practices in the field in this country.

0.5 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2 - 1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

*Rules for rounding off numerical values (*revised*).

1. SCOPE

1.1 This standard covers the method of determination of sound absorption coefficient of timber by standing wave method under normal incidence (also called tube method).

2. TERMINOLOGY

2.0 For the purpose of this standard, the definitions given in IS : 707 - 1976* and the following shall apply.

2.1 Normal Incidence Sound Absorption Coefficient — It is the fraction of normally incident sound energy absorbed by the material. The sound absorption coefficient of timber is the characteristic of the material and depends on the frequency of sound, angle of incidence, the surface quality of the material, and the moisture content.

3. APPARATUS

3.1 The apparatus is shown schematically in Fig. 1.

3.2 Impedence Tube — It consists of a long round tube of fixed length and uniform cross section with rigid walls which absorb negligible sound energy and is vibration free. At one end of the tube shall be a source of sinusoidal plane wave (*see* **3.3**) and on the other end the specimen (*see* **4**) shall be mounted. The minimum length of the tube in metre and its maximum diameter in cm shall be as given below:

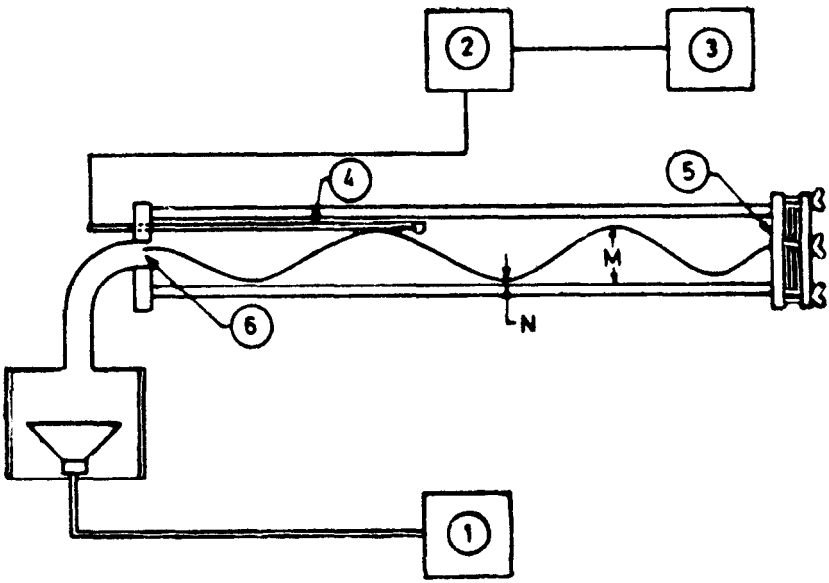
$$l_{Min} = \frac{300}{f_{Min}} \qquad d_{Max} = \frac{20\,000}{f_{Max}}$$

Where f_{Min} and f_{Max} are the lowest and highest frequencies respectively at which the measurements are desired.

3.3 Sinusoidal Plane Wave Source — An audio-signal generator shall be used to excite a loudspeaker for producing the sinusoidal plane waves.

3.4 Probe Tube — A movable microphone fixed at the end of the probe tube on the axis of the impedence tube shall be used for exploring the standing wave pattern. The probe tube including supporting fixture inside the tube shall have a cross-sectional area not greater than 5 percent of the cross-sectional area of the impedence tube and the wall thickness of the probe tube shall be not less than 1/8th of the outside diameter of the impedence tube.

*Glossary of terms applicable to timber technology and utilization (*second revision*).



1. Variable frequency audio oscillator
2. Amplifier and filter
3. Output indicator
4. Movable microphone or probe tube
5. Sample
6. Source

FIG. 1 SCHEMATIC DIAGRAM OF THE EQUIPMENT REQUIRED FOR DETERMINATION OF SOUND ABSORPTION COEFFICIENT

3.5 Output Indicator — A cathode ray oscilloscope or suitable voltmeter connected through an audio-amplifier shall be used as an output indicator.

4. SPECIMEN

4.1 The specimen shall be cut from a plank of 15 mm thickness and shall be either square or disc of side/diameter 50 mm more than the diameter of the tube. The specimen shall have a smooth surface sanded with a sand paper No. 100. The specimen shall be conditioned to constant weight at 60 $\pm$ 5 percent relative humidity and temperature 27 $\pm$ 1°C before test. The specimen shall be free from crack, split, loose or decayed knots and other defects which are likely to influence the results.

4.2 At least 10 percent planks shall be chosen from a given lot subject to minimum 10 planks and one specimen shall be taken from each plank for carrying out the test.

5. PROCEDURE

5.1 The specimen shall be mounted in the specimen holder grain direction being vertical with a rigid backing. The backing shall be of solid steel or brass plate, at least 10 cm thick. The backing shall be provided with flying nut screws to anchor it rigidly in the desired position. The fixing shall be so tight that there is no airborne transmission to outside the tube.

5.2 Sinusoidal plane waves shall be transmitted longitudinally along the tube. Waves of reduced amplitude shall thus be reflected by the specimen and these shall combine with the incident wave to form a standing wave pattern along the tube.

The pattern shall be explored by the probe tube (*see* **3.4**) whose output shall be fed to the output indicator (*see* **3.5**) to get the relative maximum and minimum pressure amplitudes in the the standing wave pattern.

5.3 Stationary wave pattern shall be produced at the following test frequencies:

125, 1 000, 2 000, 4 000 Hz

From the values of relative maximum (M) and minimum (N) pressure amplitudes, the normal incident sound absorption coefficient (a_n) shall be calculated by the following formula at each test frequency:

$$a_n = 1 - \frac{(M - N)^2}{(M + N)^2}$$

6. REPORT

6.1 Average sound absorption coefficient shall be reported at each test frequency to the nearest multiple of 0·01. It shall also be specifically mentioned in the report that this coefficient is determined by the stationary wave method at normal incidence alongwith the thickness, moisture content, species and other details of the specimens.

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