TECHNICAL INFORMATION ON BUILDING MATERIALS

TIBM - 54

FOR USE IN THE DESIGN OF LOW-COST HOUSING

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THE NATIONAL BUREAU OF STANDARDS
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RELATIVE RESISTANCE OF FLOOR COVERING MATERIALS TO ABRASION

Investigations were conducted to measure the relative resistance to abrasion of various floor covering materials, ranging from the so-called hard or stone types to the soft or organic and fibrous types.

All of the tests were made with the modified Kessler machine. The essential feature of this machine is a hollow shaft mounted in a vertical position, which may be rotated at constant speed and is free to move upward or downward. The lower end of the shaft is fitted with a cylindrical foot, two inches in diameter, with a one-inch hole drilled through the center.

Four radial slots, one-quarter inch wide, were cut in the lower face of the shoe to allow the abrasive, fed down through the shaft, to flow continuously across the surface under test. The abrasive used was 60 mesh alundum, fed at the rate of 3 to 4 grams per minute. The foot has a bearing surface of 1.86 sq. in. Means were provided for varying the pressure upon the foot. Loads of 4 3/4, 9 1/2, and 14 1/4 lb. per sq. in., respectively, were used in tests.

The shaft was rotated at 100 rpm. The test was run for twenty minutes. The loss in thickness was measured by means of a dial gauge reading to one thousandth of an inch.

Tests were made using a steel and a wooden foot at each pressure. The results showed that the relative resistance to abrasion of the samples, as indicated by the loss in thickness, was dependent upon the nature of the foot and the pressure. (See Table 1) Consequently, a foot was provided to carry strips of sole leather, and a weighted average of the results obtained at the three pressures was taken as a measure of the relative resistance to abrasion.

One-tenth of an inch was taken as the available thickness of flooring materials having a wearable thickness equal to or greater than that amount. Most of the flooring materials tested fall within this class, their thickness ranging from 1/8 in. to 2 1/2 in. Some materials, however, such as the printed linoleums, do not have an available thickness equal to one-tenth of an inch. In the case of these materials the available thickness is determined by actual measurement. The available thickness is limited in the case of the thicker flooring materials by reason of the fact that, irrespective of the total thickness, the condition of the surface is the governing factor. Under service conditions, the surfaces of floors are not worn evenly, but in grooves, caused by concentration of traffic. It is believed that when grooves reach a depth of one-tenth of an inch, the flooring would require re-surfacing for proper maintenance.

The weighted average was calculated in the following manner: The abrasion tests were made at three pressures in the ratio of 1:2:3. For each test the percent residual available thickness was calculated as the resistance of the material at that pressure. Credits of 16, 34, and 50 respectively, totalling one hundred, and approximately in the ratio of 1:2:3 were allowed for tests at each of the pressures. As a result of the test, at 4 3/4 lb. per sq. in. the percent residual thickness was multiplied by 16; at 9 1/2 lb. by 34; and at 14 1/4 lb. by 50. The sum of these products was taken as the weighted average. The weighted average became a measure of the relative resistance to abrasion of the different samples based upon tests at three different pressures using a leather foot. (See Chart I)

To study the effect of temperature upon the resistance of flooring materials to abrasion, samples were tested at room temperature and at 100°F. The results are shown in Chart II.

The resistance of flooring materials to abrasion, tested under wet and dry conditions, is shown in Chart III.

Conclusions

The modified Kessler machine is suitable for measuring the resistance to abrasion of a variety of floor covering materials.

The relative resistance to abrasion of floor covering materials is dependent upon the nature of the foot and the pressure exerted upon it.

Using a leather foot and combining the results of tests at three different pressures, a weighted average is obtained which serves as a measure of the relative resistance of flooring materials to abrasion.

Abrasive resistance is not directly related to hardness. Some of the so-called "soft" types of flooring resist abrasion better than some of the "hard" types.

Samples of the same types of flooring differ greatly in resistance to abrasion. The sample of Vermont marble was much less resistant than that from Tennessee. Linoleum and rubber tile samples show a wide range in resistance, probably caused by conditions of manufacture.

There was no appreciable difference in the resistance of flooring materials to abrasion at room temperature, as compared with tests conducted at 100°F.

The results indicate that abrasion under wet conditions is more severe than under dry conditions.

In selecting floor covering materials, the resistance to abrasion is an important factor, but other characteristics of the material should be considered. Quietness, thermal insulation, and comfort may govern the selection of flooring for certain uses. For example, granite having a high resistance to abrasion would not generally be chosen for use in a private dwelling.

It should be borne in mind that the comparison of flooring samples shown in Chart I is based upon resistance to abrasion only, measured under empirical conditions. Resistance to wear includes several factors besides resistance to abrasion.

Table 1.

Flooring Material	Loss in Thickness in Thousandths of an Inch		
	4 3/4 lb/in.^{2} Pressure	9 1/2 lb/in.^{2} Pressure	14 1/4 lb/in.^{2} Pressure
	STEEL FOOT		
Linoleum	10.0(2)	17.0(2)	23.5(3)
Cork	15.5(4)	17.5(5)	17.5(2)
Asphalt	18.5(5)	23.0(5)	32.5(5)
Rubber	4.5(1)	7.5(1)	11.5(1)
Maple	11.0(3)	21.0(4)	25.5(4)
Marble	31.0(6)	55.5(6)	70.0(6)
	WOODEN FOOT		
Linoleum	6.5(2)	18.5(3)	161.0(6)
Cork	24.5(6)	57.0(6)	95.0(5)
Asphalt	13.5(4)	19.0(4)	23.0(2)
Rubber	6.0(1)	8.0(1)	30.5(3)
Maple	8.5(3)	11.0(2)	16.5(1)
Marble	17.0(5)	25.5(5)	38.0(4)

Note: The numbers in parentheses indicate the order of resistance to abrasion.

CHART I

Relative Resistance to Abrasion of Floor Covering Materials.

Based upon weighted average of tests at three different pressures
4¾, 9½, and 14¼ lbs. per sq. inch respectively

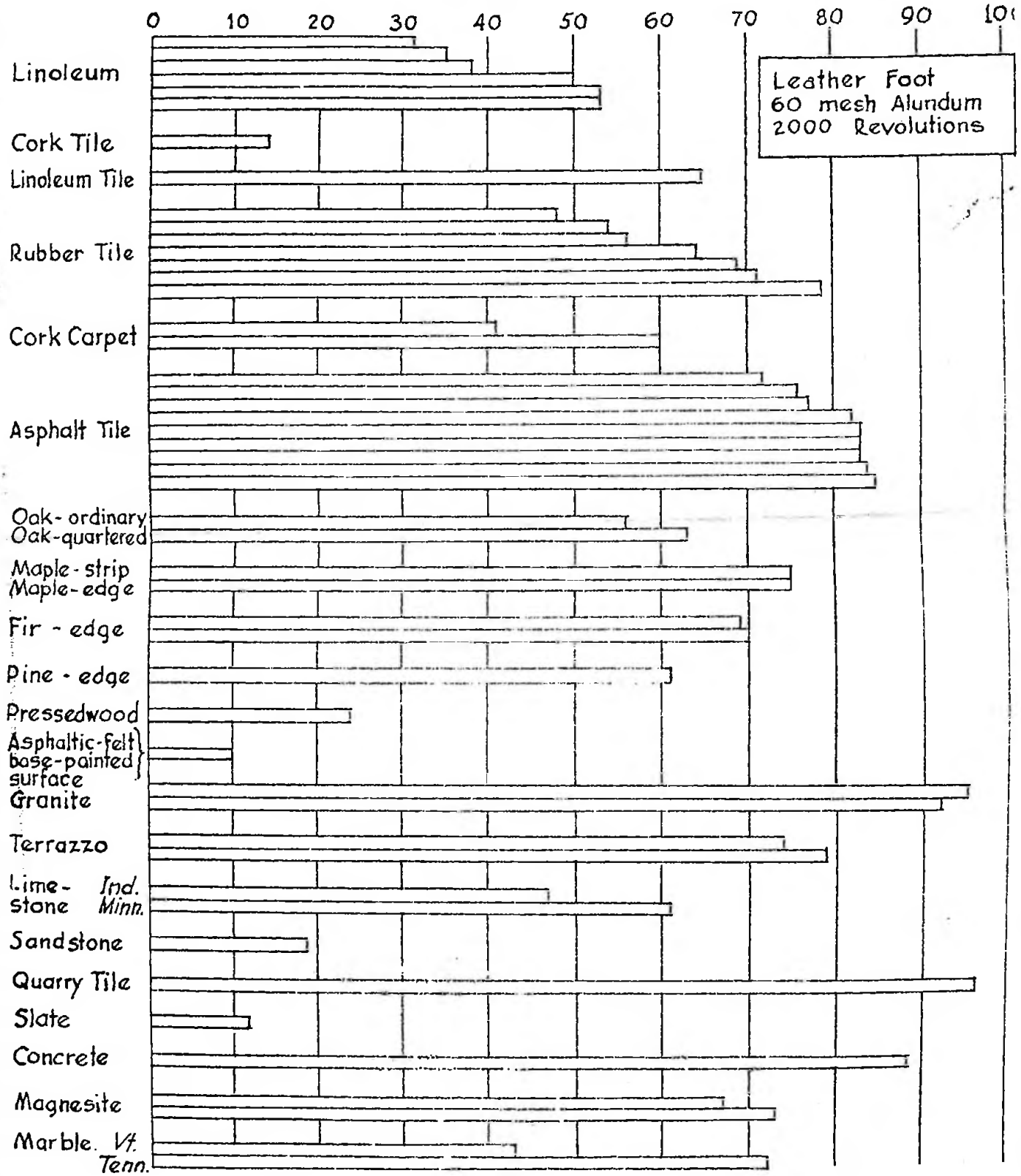

CHART II

Relative Wear of Different Materials at Ordinary Room Temperature and at 100° F

Steel Foot — 1000 Revolutions
Pressure on Foot = 4¾ pounds per sq. inch
Abrasive - Alundum (3 - 4 grams per minute)

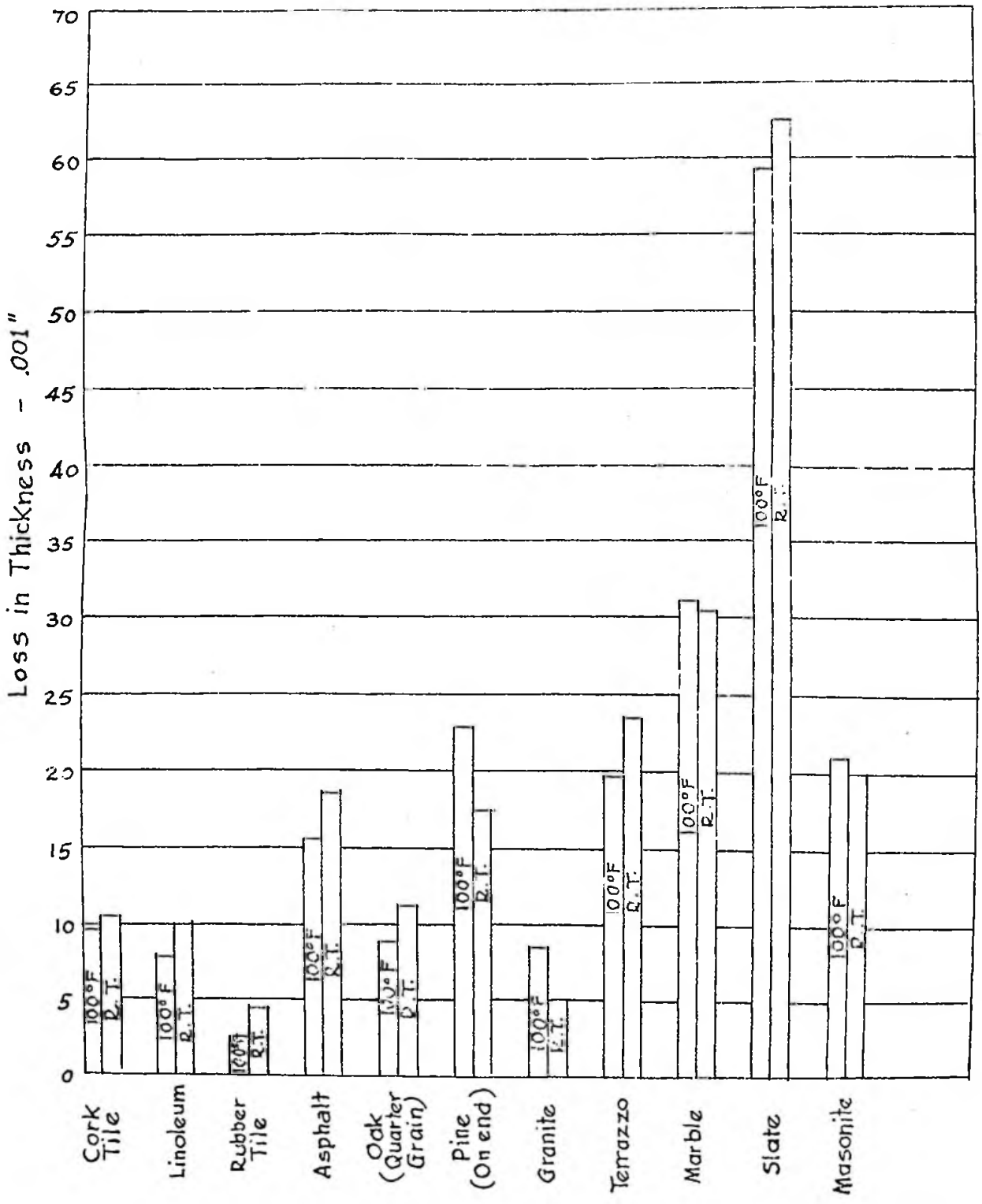

CHART III

Relative Wear of Different Materials when Abrasive is Fed with and without Water

Steel Foot ~ 1000 Revolutions
Pressure on Foot = 4¾ pounds per sq inch
Water Feed = 90 cc per minute
Abrasive - Alundum (3-4 grams per minute