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DETERMINING THE BEHAVIOR OF THE BASKETBALL, ON VERTICAL DIRECTION, ON SURFACES OF FLOORINGS CONCEIVED FOR GYMNASIUMS

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Abstract:

This work presents the results of the experiments run on a mosaic flooring (equated to concrete) and a beech wood flooring model created by us for gymnasiums (A-type panel), according to SR EN 12235, with the help of the sport flooring testing device conceived and manufactured with this purpose within Transilvania University of Braşov, called ***D-DTPS-3****.*

This endeavor is part of the PhD thesis bearing the title ***"The influence of structure upon the mechanical properties and energetic absorption of parquet-type sport hall wooden floors".***

The goal is testing fewer flooring stuctures conceived and manufactured by ourselves using local kinds of wood for gymnasiums and see if they meet the requirements and exigencies regulating this type of floorings.

Key words: *wooden floorings; sport floorings; rebound; ball; testing device.*

INTRODUCTION

Currently, the situation of wooden floorings is dynamic, concerns and research in this field trying to provide improvements/optimizations to the specific properties of wood. Due to its qualities, wood has chances to keep on being a successful material (Cismaru 2006, Cismaru et al. 2015).

A special category of wooden floorings is represented by floorings dedicated to spaces for practising dance, ballet, aerobic gymnastics and any form of exercise or sport. They are considered *special* because of their "*behavior*" as response to the activity that takes place on these floorings (Cismaru et al. 2015).

Specialists in floorings are concerned with finding that optimum balance between flexibility and rigidity, so that the user should not make an extra effort but not suffer injuries or accidents either, as well as obtaining flat surfaces – by reducing the unlevelings of the support layer (Pardoseli Magazin 2013).

Hence the great variety of floorings for sports that underwent a considerable development, mainly in what concerns the support on which the wooden panels rest on, from the most traditional system to the most innovative one (depending on possibilities and performance levels wanted for sport activities).

Despite the appearance of new materials, wooden flooring systems for sports such as basketball, squash, and dance, remain invincible because the elasticity must occur on an extended surface, not on a single point, therefore the wood is preferred over rubber (*kineticsport.ro*, "*Products*" section, "*Gymnasiums*" category, position: "*Wooden Sport Surface*", 9.11.15/h 13.41).

Testing as a scientific process in the world of sports and recreative games needs a highly specialised expertise (Kolitzus 2012). Over the last decade, many research centers developed in this field, among which stands out ***Del Tec*** from Holland (*deltecequipment.com*), developer and manufacturer of such special (mobile) sport flooring testing equipment.

Subsequently to the study run on 51 different flooring materials (Demker 2009), the elaboration by Swedish Standards Institute of a global standard for measuring the mechanic comfort for all flooring types, both in situ and in the laboratory, was recommended, the testing methods existing in EN 14808 and EN 14809. As in this field, at international academic level, published studies and research results are very rare, we are constraint to refer only to those mentioned above and the regulations imposed by standards and established sport institutions (*European & International Standards. Surfaces for sports areas. A short guide. 2014*).

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OBJECTIVE

The objective of this research is realising floorings with a nationally high grade performance, competitive with the ones previously mentioned. We will watch the graph of the rebound of the basketball on a concrete/mosaic surface that will be considered as a yardstick in comparing the response that the wooden structures proposed by us will give. By means of this method we verify if the structures conceived and manufactured meet the requirements imposed by sport institutions as well as by national and international standards for gymnasiums.

MATERIAL, METHOD, EQUIPMENT

In order to design correctly the wooden floors dedicated to this type of activity – sports – preliminary testings were performed consisting of bending testing samples made of steamed domestic beech wood of different thicknesses (15, 20, 25, 30mm), widths (30, 40, 50, 60mm) and lengths (300, 350, 400, 450mm) to observe the behavior and make possible a right choice regarding the dimensioning of the friezes for the panels that will be tested. Following the preliminary analysis, it was chosen for the parquet friezes to be 20x50x500mm. The friezes from the carpet were arranged/assembled according to the English model.

The parquet friezes were manufactured in the Multi-functional Wood-processing Workshop (HI 5) within the Wood Engineering College of Transilvania University of Brasov, going through the following stages (Fig. 1):

a) severing – circular saw

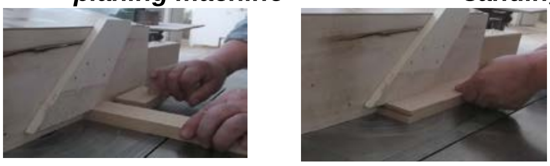
b) splitting – circular saw

c) face-edge straightening – straightening machine

d) planing to width – width-planing machine

e) calibrating – wide tape sanding machine

f) cutting to length - circular saw



g). groove milling – normal/vertical axis milling machine (MNF); 5mm mill

h). groove milling – normal/vertical axis milling machine (MNF); 5mm mill

Fig. 1.
Realising parquet friezes – Stages.

After manufacturing the parquet friezes, because the SR EN 12235 standard provides that the minimum area for testing must be at least 1,00mx1,00m, the structures conceived have this area except the last one which is 1,50mx1,50m. The friezes in the carpet were glued with JOWACOLL® 103.05, leaning on resinous wood beamlets. Fewer structure variants were realised, i.e. type A and type B panels leaning on 3 beamlets, the difference between them consisting of the dimension and arrangement mode of the friezes. For panel C we have the leaning on 5 beamlets. For type D panels we have leaning on beamlets and traverses, the difference consisting of the 15, 20 and 25mm frieze widths. The last type E panel is 1,50mx1,50m and rests on beamlets and traverses.

Experimental research belonging to this work refer only to the type A panel structure. Its characteristics are presented in Table 1 and type A panel structure is presented in Fig. 2.

Table 1

Type A panel - Characteristics

Structure type A panel (1,00mx1,00m)							
friezes				**beamlets**			
thickness	width	length	total	thickness	width	length	
mm	mm	mm	pcs	mm	mm	mm	pcs
20	50	500	40	20	40	1000	3

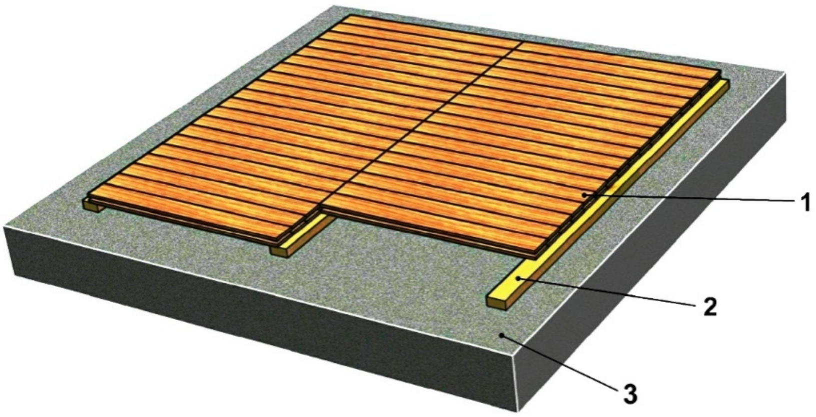


Fig. 2.
Type A Panel Structure.
1 – beech wood parquet frieze; 2 – resinous wood beamlets; 3 – concrete support layer

Beech wood parquet friezes, dimensions: 500x50x20mm are arranged like floors and glued with JOWACOLL® 103.05, resting on 1000x40x20mm resinous wood beamlets, disposed at a 500 mm distance between each other axis, fixed with 3,5x30mm wood screws (Fig. 2). The panel is attached to the support layer with 6x65mm screws.

The support layer for the tested structures/panels is composed of the mosaic flooring equated to the reinforced concrete layer over which quick primer for non-absorbing supports (Super primer from BAUMIT) was applied and a 2-3mm auto-leveling screed (Nivello Duo from BAUMIT) was cast to ensure flatness.

As working method, we used a procedure elaborated according to SR EN 12235 stipulating that the height of the ball rebound from a sport surface is calculated using the ecuation (1):

$$R\% = \frac{R_s}{R_c} \times 100 \qquad (1)$$

where:
R% - the relative height of the rebound, as a percentage;
Rs - the height of the rebound from a sport surface, in meters;
Rc - the height of the rebound from concrete, in meters.

Therefore, we conceived a testing device meant to be in accordance with the provisions of SR EN 12235 standard, as well as the 2016-2017 General regulations for organizing basketball competitions (RGOCB).

The testing equipment presented in Fig. 3 is conceived and realised within the premises of Wood Engineering College.

The functioning principle of the device consists of fastening the ball (RGOCB) inside a ring-band with 3 elements (2 fixed and one with mechanical retraction) and releasing it from a 1.80m height (acc. to SR EN 12235). By means of an ultrasound device – *Einstein*™ ***Distance Sensor*** (*Distance Sensor DT020-1*) we measure the height to which the ball rebounds after falling on the panel subjected to the testing. The calculation of the rebound height is done using the ***MiLAB*** software installed on a dedicated digital tablet that allows data collection, display, and analysis, transforming the ball motions in relevant graphic representations.

Fig. 3.
D-DTPS-3 Testing device.

The ball used for testings is the MOLTEN 7 ball, Fig. 4, the official game ball for competitions organized under the aegis of FRB, in accordance with the RGOCB.

Fig. 4.
Basketball used for testings.

RESULTS AND DISCUSSION

Within the experiments regarding measuring the value of the maximum rebound of the basketball on a concrete/mosaic surface, 5 (five) measurements were performed, according to the SR EN 12235 standard stipulating that the ball must fall from a 1.8m height.

Fig. 5 presents the variation of the maximum rebound corresponding to the five measurements for three diffferent inner ball pressures.

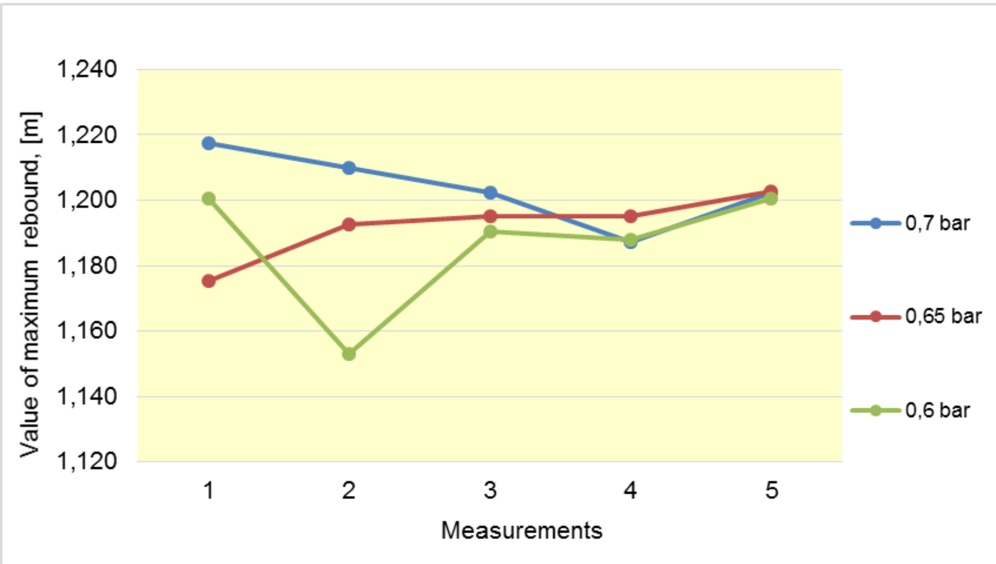


Fig. 5.
Variation of the maximum ball rebound on the concrete/mosaic surface at three different inner ball pressures.

Fig. 6 represents the maximum rebound of the ball inflated at three different pressures, related to the average of the five measurements, compared to the value stipulated in the standard.

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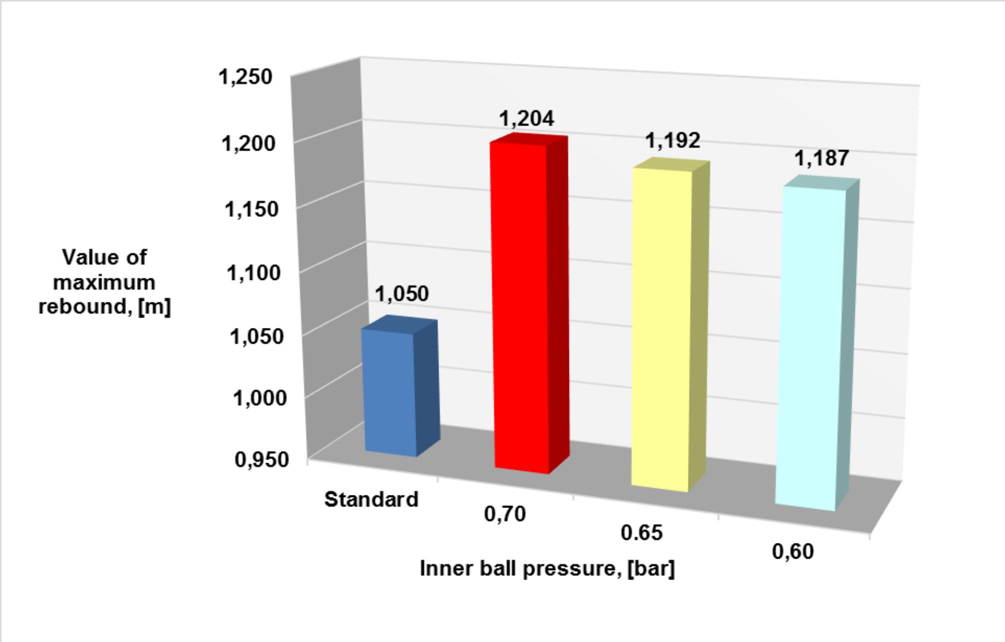

Fig. 6.
Comparative graph regarding the standard value and average of measurements of maximum ball rebound on the concrete/mosaic surface at three different inner ball pressures.

Thus, we find that the diferrent inner ball pressure, respectively 0.7, 0.65, and 0.6 bar influences visibly the basketball rebound when it dropped from a 1.8m height (acc. to SR EN 12235).

The graph below, Fig. 7, presents the results obtained by testing in 5 points a type A wooden panel.

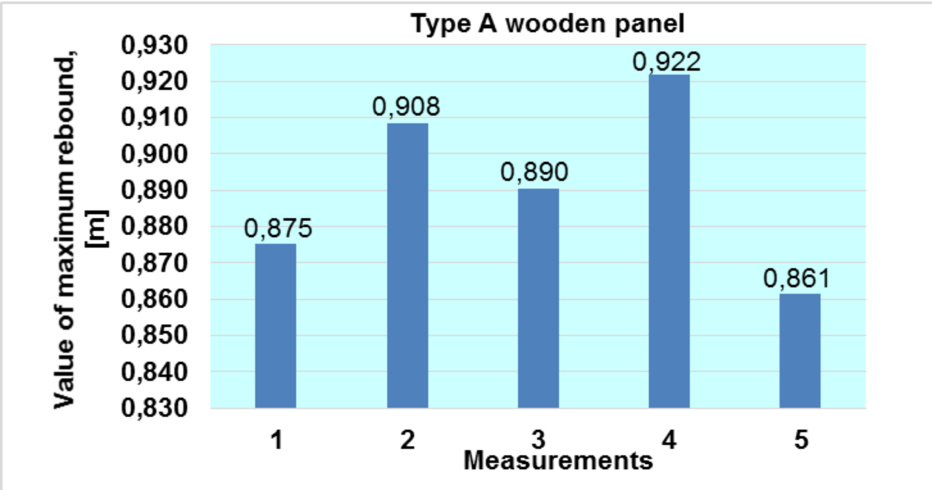

Fig. 7.
Graph for 0.7 bar inner basketball pressure using a type A wooden panel.

For sport floorings, the vertical aspect of the ball (after the impact with the floor), according to EN 12235 (basketball game), must be at least 90%.

Type A flooring made it to only 74%. This demonstrates that this type of flooring is not reccomended for halls where such sport activities unfold.

CONCLUSIONS

The results obtained from the testings performed on the concrete/mosaic surface demonstrate that the inner pressure of the ball used for testing has a very high influence as well. Therefore, we will do all testings on the structure conceived and manufactured in order to realise the PhD thesis with one inner ball pressure only, i.e. the 0.7 bar one. This way, the yardstick for concrete/mosaic will be 1.204m, all relations being done to this value.

After the testings performed on the type A wooden panel that has the structure composed of 20x50x500mm friezes arranged as floorings and resting on 3 (three) beamlets, we found that this one responded with only 74% versus 90% which is the minimum accepted for sport floorings. Therefore, this type of flooring is no recommended for halls where basketball is played.

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