Gluing of panel parquet products in passage presses

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Abstract. The article indicates the weak points of parquet assembly and gluing automatic lines with a relatively short cycle time, which is usually a press section based on positioning equipment, which is proposed to be replaced by straight-through presses of a simplified design. A method for gluing wooden floor coverings based on a through-feed press is proposed. To eliminate the spread of pressure acting on wood blanks of different thickness, it is proposed to use rubber gaskets based on spongy rubber, glued to the working surfaces of the tracks. The values of the actual spread in the thicknesses of the parquet planks and the mechanical characteristics of elastic pads are experimentally determined. The article provides conclusions about the suitability of a continuous press with tracks equipped with elastic elements for the production of panel board parquet and the feasibility of introducing such equipment.

1. Introduction
One of the methods for assembling and gluing panel wooden floor coverings is the so-called assembly method, the essence of which is a short-term force effect on the surfaces to be glued and a sharp decrease in the magnitude of the force effect [1]. As a result of this treatment, the surfaces to be glued stick together during the piezo-treatment process and further hardening of the glue outside the pressing equipment. In this case, the minimum allowable pressure values are 0.01 ... 0.02 MPa, and the holding time under pressure is no more than 5 seconds [2].

This method is most applicable to panel board flooring wooden coverings, since the face layer of these products glued to the substrate consists of strips with lengths usually not exceeding 200 mm. With such a length of planks and a low pressing force, elastic bending of wood fibers is not observed, which means their elastic recovery after pressure release, which ensures the assembly integrity of the entire structure during the period of final polymerization of the adhesive seam [3, 4].

Problem. The specified features of the assembly method of gluing make it possible to use it in parquet assembly-gluing automatic lines with a relatively short cycle time (12 ... 15 seconds) [5].

2. Methods and Materials
The bottleneck of such lines is usually a press section based on positioning equipment, which is proposed to be replaced by straight-through presses of a simplified design. The photograph of a prototype of such a press, manufactured and tested within the walls of the Saint-Petersburg State Forest Technical University named after S.M. Kirov is shown, figure 1.
Figure 1. Crawler press for gluing wood flooring.

Through-type pressing devices are widely used in woodworking in the manufacture of sheet and panel materials. By the type of pressing elements, they are divided into roller, calender, caterpillar, tape-rolling. Caterpillar presses are most suitable for gluing laminated panel board products, since they provide a short but sufficient holding of products under an almost constant or smoothly varying pressure.

The experimental setup consisted of a caterpillar press, consisting of the upper and lower contours of plate chains of the B 125-20-1 type, equipped with tracks, which were the main pressing working elements. The tracks of the contours in the pressing zone with internal (non-working) surfaces rested, through blocks of rolling bearings, on base plates, the upper one of which was made movable.

The pressing force was created due to the deformation of rubber pads 4 mm thick, glued to the working surfaces of the tracks. The pressing force was adjusted by moving the upper chain contour using manual screw mechanisms. The package to be glued was fed into the gap between the upper and lower tracks, the calculated value of which determined the pressure. The pressure was calibrated using dynamometers. The length of the working zone of pressing was taken equal to 1250 mm, the value of the feed rate $V_{pod} = 2.0 \text{ m/min}$.

3. Results and Discussion

During preliminary experiments on gluing parquet boards, it was revealed that the real spread in the sizes of parquet planks in thickness significantly differs from the requirements of the current GOST 862.1-85 “Parquet products. Piece parquet. Specifications” [6], GOST 862.4-87 ”Parquet products. Parquet boards. Technical conditions” [7]. This leads to the fact that when gluing between rigid pressing elements, a part of the "low" strips of the front covering does not experience pressing loads, since the "higher" strips prevent the contact of the press plates with the "low" strips.

In experimental studies, three main tasks were posed: experimental determination of the actual spread in the thicknesses of parquet planks manufactured in production conditions; determination of
mechanical characteristics of elastic gaskets; determination of the quality of gluing parquet boards in continuous-type presses and the use of glue based on polyvinyl acetate dispersion (PVAD).

When manufacturing parquet planks in accordance with GOST 862.1–85, GOST 862.4–87 [6, 7], their thickness deviations should not exceed ±0.2 mm. To determine the actual thickness deviation of the parquet planks, measurements were made of the thickness of the parquet planks manufactured under production conditions. Lots of parquet planks were selected by random selection at regular intervals at the beginning, middle and end of sawing work until their next regrinding. The total number of parquet planks selected for the survey was 500 pieces. The nominal dimensions of parquet planks are 150×30×8 mm. The wood species is beech, with a moisture content of 8 ± 2%. The thickness of the planks was measured at three points: at a distance of 10 mm from the ends at half the length of the axial line of the plank with an accuracy of 0.01 mm. The results of bar measurements is shown, figure 2.

![Figure 2. Distribution of planks by thickness.](image)

It can be seen from the above graph that the actual deviation of the parquet strips of the front covering in thickness is up to ±0.5 mm, which exceeds the deviations allowed by GOST by 2.5 times. Gluing panelboard parquet with such a range of sizes of planks in thickness using presses with rigid plates is practically impossible. Therefore, the transfer of forces was carried out using elastic pads installed on the press tracks.

The material of the gaskets was spongy rubber with a single layer of 4 mm, manufactured by continuous technology on the basis of solid rubber with soot filler PC 2520-70.

Determination of the mechanical characteristics of elastic gaskets for different numbers of sheets was carried out on a P12M press. Compression strain was measured using indicators with a graduation of 0.1 mm.
An elastic strip, composed of several sheets, the surfaces of which were powdered with talcum powder, were loaded with deformation registration. The thickness of the spacers \( h \) depended on the number of layers and was: \( h = 4 \) mm (one sheet), \( h = 8 \) mm (two sheets), etc.

According to the results of the measurements, it was found that the modulus of elasticity in compression of the gaskets selected for the experiments lies within the range of \( E = 0.26 – 0.30 \) MPa is shown, figure 3.

\[
\sum P_i \cdot F_i = P
\]

where, \( P \) – the total pressure of the pressing device; \( P_i \) – pressure on a group of elements having the same or admissibly close thickness; \( F_i \) – the area of elements (strips).
The pressure on the group of elements $P_i$ depends on the difference in thickness of the strips, the thickness and modulus of elasticity of the gasket.

The arrangement of groups of planks in increasing thickness is shown next to:

$$\Delta h_1 = h_1 - h_{\text{min}}; \quad \Delta h_2 = h_2 - h_{\text{min}}; \ldots \Delta h_n = h_n - h_{\text{min}}$$

(2)

where, $h_1, h_2, \ldots, h_n$ – thickness of the glued strips; $h_{\text{min}}$ – the minimum thickness of the glued strips.

The pressure on a group of planks $P_i$ having the same thickness is determined by the formula:

$$P_i = a \cdot \Delta h$$

(3)

where, $a$ – coefficient taking into account the geometric and elastic characteristics of the gasket.

Then the average pressure of the pressing device can be determined by the formula:

$$P = P_{\text{min}} \cdot F_{\text{min}}' + P_1 \cdot F_{h1}' + P_2 \cdot F_{h2}' + \ldots + P_n \cdot F_{hn}'$$

(4)

where, $P_1, P_2, \ldots, P_n$ – pressure on a group of elements having the same thickness; $F_{\text{min}}', F_{h1}', \ldots, F_{hn}'$ – area (in shares) of a group of planks having the same thickness.

The results of calculating the average pressing pressure, taking into account the elastic and geometric parameters of the gaskets, for a parquet board with dimensions in terms of 0.6×0.6 m and strips of the front covering with dimensions of 150×30×8 mm is shown, figure 4.

![Figure 4](image-url)

**Figure 4.** Dependence of pressure on the thickness of the facing strips at the thickness of the gasket: 1 – 4 mm; 2 – 8 mm; 3 – 12 mm; 4 – 20 mm.

It is easy to see that with an increase in the thickness of the elastic pad (or with a decrease in the elastic modulus of the pad material), the total pressing force decreases. However, the use of very thick gaskets made of rubber that is too pliable is undesirable due to the increased wear of the gasket.
material. The optimal should be the use of gaskets with a thickness of 10 ... 15 mm with the modulus of elasticity of the gasket material $E = 0.2 \ldots 0.5 \text{ MPa}$.

Previously, we determined that when using an adhesive composition based on PVAD, the pressing pressure when gluing parts is 0.01 MPa. Taking this into account, in the experiments carried out on gluing panel structures in a caterpillar press, it is possible to neglect the deformations of wood and evaluate only the deformation of elastic gaskets. Then, with a spread in the thicknesses of the parquet planks $C = \pm 0.5 \text{ mm}$, the modulus of elasticity of the spacer $E=0.3 \text{ MPa}$ and the thickness of the spacers, for example, $h = 12 \text{ mm}$ using formula (4), the force $P$ when gluing the board is 0.0224 MPa.

With the dimensions of the parquet board in terms of 600 $\times$ 600 mm, its area is $F = 0.36 \text{ m}^2$. Then the total pressing force will be:

$$P = P_{\text{nom}} \cdot F = 0.0224 \cdot 10^6 \cdot 0.36 = 8000 \text{ N}$$

(5)

Such a small amount of pressing force allows us to conclude that the use of powerful hydraulic presses in the production of glued panel structures is irrational. Knowing the mechanical characteristics of elastic gaskets and the actual thickness difference of the parquet planks of the front covering, it is easy to determine (according to the graphs similar to those shown in figure 4) the additional pressure required to create optimal conditions for gluing the "thinnest" planks. With this data, it is possible to determine the nominal specific pressure during bonding and the total pressing force in real production conditions.

The experiments carried out allow us to conclude that a continuous press with tracks equipped with elastic elements is quite suitable for the production of panelboard parquet, and the introduction of such equipment is expedient.

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