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«Modeling and multicriterial optimization of the mortise forming process in pine wood blanks»

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Актуальность

- The forming of the joint profile is an important stage in the technological process of manufacturing joints for wood splicing. A promising direction for improving this technology stage is the development of waste-free methods for the formation of high-quality finger joints using the technique of local pressing in the longitudinal direction. The introduction of technology into the production process requires a reasonable choice of the parameters of technological modes. One of the most important output parameter of the pressing process is the hardness of the mortise bottom, together with the pressing force and the depth of the densified zone.
- The first task of the research is the development of a model describing the impact of the technological modes on the hardness of the mortise bottom.
- The second task is the determination of the modes at which the resulting process parameters, or output functions (pressing force, depth of the densified zone, hardness of the mortise bottom) acquire optimal values.

Методы решения

- The experiments were organized using a second-order non-compositional plan for three factors (Box-Behnken design).
- Data processing, their statistical analysis, and obtaining a regression model were carried out using the Statistica software package with a confidence level of 95 %.
- The obtained regression model for predicting HRL was used to solve the multicriterial optimization problem to determine the rational values of the parameters of the pressing modes.
- The objective function was developed according to the principle of a fair compromise, which allows finding the optimal solution taking into account several optimization criteria.
- The search for the extreme values of the responses F_e , h_3 , HRL was carried out using the generalized reduced gradient method. The solution process was implemented in the Microsoft Excel software package using the Excel Solver add-in.
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ВЫВОДЫ

Результаты, внедрение

- The recommended values of moisture content are at the lower limit of the variation range of the factor W . This indicates the advisability of pressing when the moisture content of wooden blanks is close to the operational value when used indoors.
- The value of the mortise depth can be taken as the maximum of the investigated range. This makes it possible to produce multiple mortises and, accordingly, tenons with increased length, which improves the strength of the joint .
- The optimal value of the control factor "mortise width" $B = 4 \text{ mm}$ is located at the lower limit of the variation range. This indicates the promise of making thin tenons. The objective function has potential in this direction. This result is significant for the design of joints: multiple thin tenons (with thicknesses about 2 mm) can be effectively used for splicing.
- The values of the process parameters determined as a result of solving the optimization problem can be used to implement the technology of end pressing of joints in an industrial environment. The values of the control factors W, h_n, B are necessary for organizing the process, and the values of the output (controlled) parameters F_e, h_3, HRL - for planning the result obtained.

Контакты

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