Mixed-integer linear programming formulation for a two-stage two-dimensional dual bin packing problem for wood reuse optimization

The increasing demand for raw materials such as wood undoubtedly contributes to the depletion of natural resources and global warming. To curb this phenomenon, a more sustainable and circular management of wood could be developed through the intelligent management of wood waste. This wood waste can be in the form of beams or pallets and could be considered as wooden slats. They could be combined, assembled, and glued to build Cross-Laminated Timber (CLT) panels for the construction industry.

We aim to develop optimization techniques to recycle raw wood waste to create two-dimensional CLT panels of variable dimensions. The input waste is in the form of slats with variable and heterogeneous lengths and widths but constant thickness. The algorithm provides the assembly schemes that maximize the amount of wood reused through the production of CLT panels.

We conducted a literature review to identify our problem in the field of operations research and to name it accordingly. The present work addresses an exact case of the two-stage two-dimensional dual bin packing problem (E-2S-2D-DBPP) in the context of wood reuse optimization.

We propose a description of the problem and a mathematical formulation with cuts. We also present the results of several numerical experiments based on realistic instances from the wood industry obtained by using Gurobi's B\&B procedure. Finally, we identify the size limit of the instances for which the problem can still be solved in a reasonable time.