Binary linear programming formulation for a two-stage dual bin packing problem for wood reuse

The increasing demand for raw materials such as wood is undoubtedly contributing to the depletion of natural resources and global warming. To curb this phenomenon, a more sustainable and circular management of wood could be developed by intelligently handling 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 by providing assembly schemes to create CLT panels. The goal is to minimize the waste, which is the wood that could not be reused in the CLT panels.

We conducted a literature review to identify the closest problems in the field of operations research and to name our problem accordingly. The skiving stock problem and the dual bin packing problem, which is not a dual version of the cutting stock/bin packing problem, are the two closest problems to ours. The present work addresses for the very first time an exact case of the two-stage two-dimensional dual bin packing problem (E-2S-2D-DBPP) in the context of wood reuse.

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 and identify the size limit of the instances for which the problem can still be solved in a reasonable amount of time.