

The ship placement problem: Decision support through exact decomposition

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Ships must often pass one or more locks when entering or leaving a tide independent port. So do barges travelling on a network of waterways. These locks control the flow and the level of inland waterways, or provide a constant water level for ships while loading or unloading at the docks.

We consider locks with a single chamber or several (possibly different) parallel chambers, that can transfer one or more ships in a single operation. When transporting ships through such a lock, three problems need to be solved: selecting a chamber for each ship, placing ships inside the chamber, and scheduling the resulting lockages.

The present contribution considers the ship placement problem, which constitutes a daily challenge for lock masters. This problem is closely related to 2D bin packing, and entails the positioning of a set of ships (rectangles) into as few lockages (bins) as possible while satisfying a number of general and specific placement constraints.

A decomposition model is presented that allows for computing optimal solutions in a reasonable time. Experiments on simulated and real-life instances show that the decomposition model generates feasible solutions, while maintaining acceptable calculation times. The decomposition approach is part of a decision support tool, which allows lock masters to compute and compare several solutions for a set of arriving and departing ships. Live tests have shown that the tool's flexibility and high solution quality may help the lock masters in making quick and informed decisions.