Solving a Rich Vehicle Routing Problem Arising in the Steel Industry

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Abstract

We study a variant of the capacitated vehicle routing problem inspired by a real world problem setting that occurs in steel producing factories. Steel slabs are heterogeneous items that appear at locations at certain release times and need to be transported to other specified locations within the factory before a certain due time. Every steel slab is assigned a profit representing its production value. We are given a fleet of standard vehicles and a fleet of truck and trailer type vehicles. The trucks serve as towing vehicles for trailers and they cannot hold any steel slabs of their own. Meisel F. and Kopfer H. (2014) have already contributed to similar problem settings where a truck pulls a trailer and a trailer is used for holding cargo. Our work additionally takes into account that both the standard vehicle and the trailer can carry several slabs at once up to a capacity limit. Also, our model allows slab transshipments among vehicles. The input is such that not all slabs can be delivered in time during the considered time horizon. Therefore, the objective function is organized in a lexicographic fashion: first, maximize the throughput-related profit; second, minimize the fleet size; third, minimize travel times. We propose a Mixed Integer Programming (MIP) representation of the problem. For solving large scale problems, we develop a Large Neighborhood Search (LNS) algorithm. As this work is motivated by a problem faced by our industrial partner, we also compare our results to their provided solutions revealing significant improvements.

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