表 4　板材尺寸及其规范尺寸子板数量

Table 4　Sheet sizes and the number of sub sheets with normal size

ID	$\bar{L}$	$\bar{W}$	$\lvert G_L \rvert$-1	$\lvert G_W \rvert$-1	$(\lvert G_L \rvert-1)\lvert(G_W \rvert-1)/(\bar{L}\bar{W})$
H	109	85	33	60	0.21
HZ1	72	62	69	43	0.66
M1	84	124	47	73	0.33
M2	215	242	153	86	0.25
M3	242	398	70	155	0.11
M4	420	443	116	138	0.09
M5	629	643	122	145	0.04
B	2635	2935	1820	2554	0.60
UU1	381	399	170	204	0.23
UU2	597	626	333	321	0.29
UU3	873	778	388	316	0.18
UU4	784	955	443	569	0.34
UU5	1151	1038	693	642	0.37
UU6	1626	1115	648	494	0.18
UU7	1164	1613	742	943	0.37
UU8	1594	1534	913	829	0.31
UU9	1949	1958	1046	1043	0.29
UU10	2788	2749	1303	1541	0.26
UU11	3463	3657	3013	2460	0.59
HZ2	81	67	24	55	0.24
UW1	389	383	207	218	0.30
UW2	447	594	308	354	0.41
UW3	559	519	300	310	0.32
UW4	985	811	622	532	0.41
UW5	871	1141	451	474	0.22
UW6	1392	1217	763	720	0.32
UW7	1764	1498	904	836	0.29
UW8	2106	2197	1115	1262	0.30
UW9	2400	2113	1512	1087	0.32
UW10	2794	2899	1525	1555	0.29
UW11	463	534	365	426	0.63

4.5　实际生产实例

用本文算法求解文献[18]的 4.4 节桂林客车厂的排样实例，算法求得了最优解，耗时 0.86 分钟；文献[18]两段算法和文献[6]精确算法也求得了最优解，分别耗时 1.6 分钟和 21 分钟（硬件环境与本文算法相同）。可以看出本文算法在计算时间上优于文献[18]算法和文献[6]精确算法。

5 结 论

针对矩形件无约束二维剪切排样问题，设计了一种简单块占角排样方式，构造了其动态规划生成算法，这种排样方式能使同种矩形件尽量聚集在一个块中，有利于板材切割工艺。本文算法是剪切排样方式的启发式算法，与剪切排样方式的其他启发式算法相比，本文算法排样价值高于同质块 T 型排样算法、同质块两段排样算法、经典三阶段排样算法、普通占角排样算法、复合条带两段排样算法、改进的三阶段排样算法和匀质条带三块排样算法，计算时间比前 4 种算法短，比后 2 种算法长。与剪切排样方式的精确算法相比，本文算法计算时间远

小于精确算法，优化结果非常接近精确算法。本文算法设计思想比较简单，计算时间能满足实际应用需要。

由于本文算法只考虑单张板材上矩形件的无约束排样，故只能生成单张板材上矩形件的排样方式；对于每种矩形件需求量已知的下料问题，本文算法暂无法解决。今后可将本文算法作为排样方式生成算法与线性规划、整数规划和顺序启发式算法相结合来求解矩形件 2 维剪切下料问题。

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