A PROBLEM OF CUTTING OFF THE LAMINATED SEMIS TYPE PLATE

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Abstract: *A problem often coped on many domains such as wood manufacturing, glass, plastics and metallic platework industry, is the shaping or cutting off a big plate in many pieces.*

With this purpose there are algorithms of optimizing for positioning the parts following to be cut off from a row plate. From mathematical point of view, in positioning the parts on a raw plate the number of solutions increase four times evrey time a new part is added, and in case of finding the best solution for about few hundreds of pieces or parts would require years of processing on the most performant computers nowadays – for an analogy remember the famous story with the rice beads which the King had to pay to the master teaching him the chess: twice more for each square of the chessboard; for the total quantity assessment, King ascertained that the crops in his whole life wouldn't have been enough.

Keywords: algorithms, plate, optimized

1.Introduction

The best approach in this case is finding a proximate solution in convenient time, the best results being given by „genetic algorithms", a class of algorithms insspiring from the biology. A correct mathematical approach, in a relatively short period of time, may offer you solutions very close to the optimal solution; thus, the positioning of the parts on a large plate, in case of a human-intuitive placing, has about a coverage of 75-80%, after a long experience on this domain and with the allocation of a significant time period.

The use of some mathematical algorithms leads to results of 90-95% coverage, in real cases, therefore a material economy over 10%:
-300 parts on 11 plates; 96% coating;
-70 parts on 7 plates; 93% coating;

2. Working manner

The problem is based on the following question: „Is it possible that from 18 rectangular parts having the sizes 1x2 to be made a square so that no straight „joint" or „seam" to unify the opposite sides of the square, working on the edge of the plates ?" For instance, in figure 1 it is presented a version which isn't good as it appears the „joint" AB.

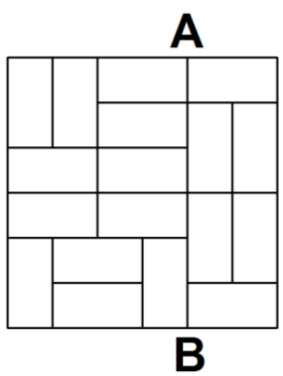

Fig.1.

Let's suppose that we have succeed making a 6 X 6 square from the plates 1 X 2 without any „joints”. Then, any of the 10 lines cutting off this square in little squares of 1 X 1 has to cross at least a plate 1 X 2. It is not difficult to prove that every line as above crosses mandatorily an even number of plates. Every such line cuts off the square 6 X 6 a rectangle 6 X k which consists of an even number of smaller squares 1 X 1.

This rectangle contains a whole number of plates 1 X 2 and another even number of small squares1 X 1, half of the small plates cut off the line from the figure 2.

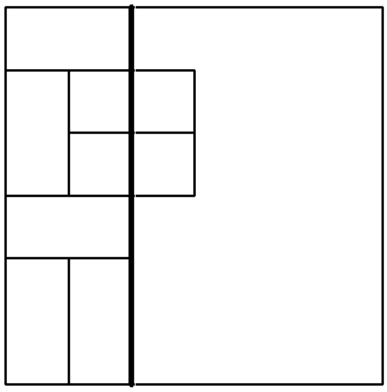

Fig.2

But if each line crosses at least two plates, then the total number of plates has to be at least 2 X 10 = 20, while their number is 18. Thus we have proved that the square 6 X 6 cannot be cut off in small plates in the required manner.

Therefore, the following general problem could be tackled: when a rectangle *m x n* can be divided in 1 x 2 plates without joints or seams? It can easily be proved that the rectangles 2 x n, 3 x n, 4 x n, cannot be cut off this way.

But if m ≥ 5, n ≥ 5 and *m x n* is even (the last condition is obviously necessary), then in all cases, except the one previously studied, 6 x 6, there is the required condition. For proving it is enough to be studied the parting of the rectangles 5 x 6, and 6 x 8 and to be then observed that from the parting of the rectangle *m x n* it is easily obtained the parting of the rectangle m + 2) x n (fig.3, fig.4).

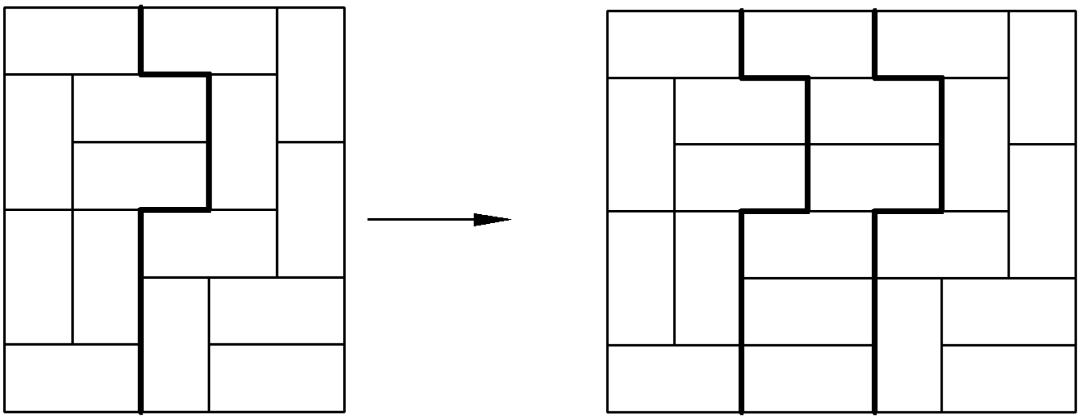

Fig.3.

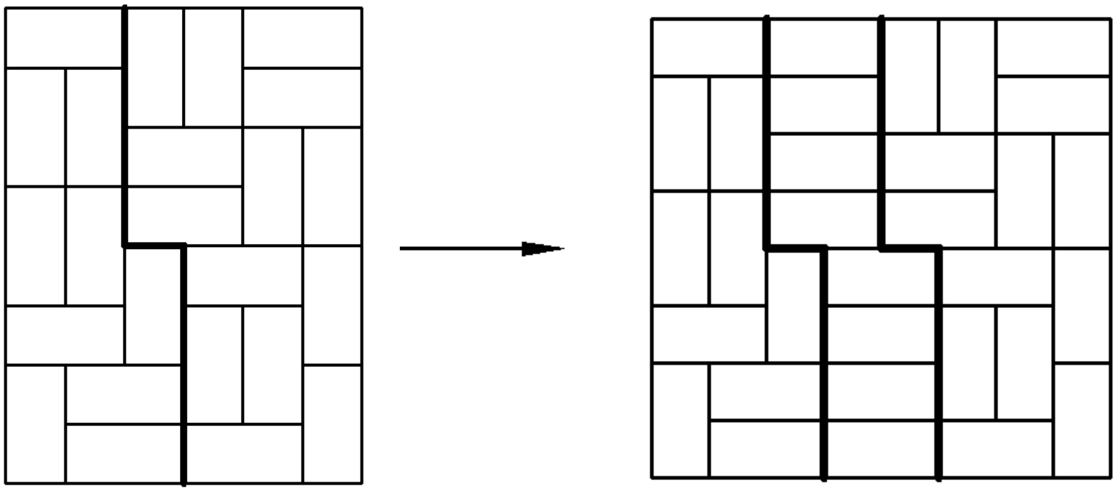

Fig.4.

3.Conclusions

The specification of the quantities and dimensions of the plates to be cut off and also of the parts :
- not only raw plates as raw materials can be used, but also remained parts obtained from a previous order made from a material with the same code;
- it can be imported automatically a data basis with materials;
- many orders can be merged in a single optimized cutting off instance, so that the losts of material to be minimum and the total execution time decreases ;
- raw plates can be used in a specified order – including the sorting depending on their areas – so that the raw material storehouse to be strictly used in a desired manner.

4.References

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