Optimization Study on Yield of CNC Cutting Wood-based Composite Panels for Upholstery Furniture Frames

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1 Introduction

In today's competitive world, many furniture manufacturers are improving the efficiency of their process, eliminating unnecessary costs, and improving quality by using wood-based composite panels in their frames. Upholstery furniture frames, today, are made by using over 70 percent wood-based composite panels (APA 2001). CNC router technology allows the manufacturers to increase their design production efficiencies by using wood-based composite panels (Konukcu 2014). The manufacturers indicated an improvement from a 30 to 40 percent yield with hardwood lumber to a 90 percent yield with wood based panel (APA 1997).

Figure 1. An example of upholstered furniture.

2 Objectives

The primary of the study was to obtain efficient material utilization for CNC layouts.

The specific objectives were to study the effects of frame sets cut, panel sizes, and curved & small parts on the cutting yield.

3 Materials

Data files used in this study were provided from an upholstery furniture manufacturer, which is located in Mississippi, USA. The selected model is made from three different types of wood-based composite panels.

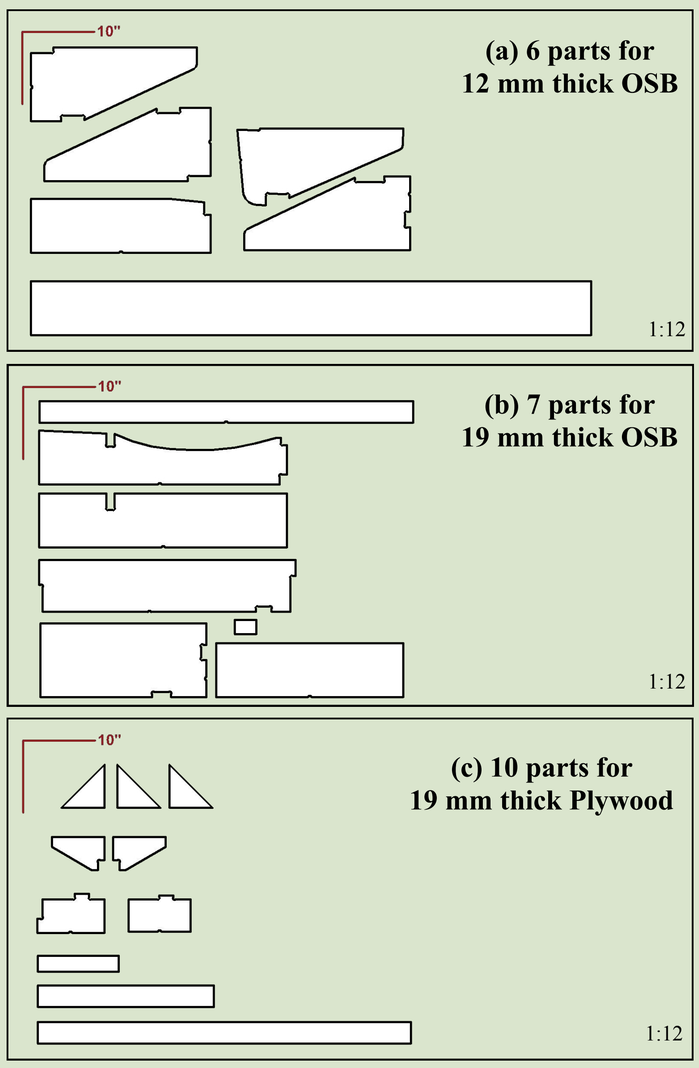

Figure 2. AutoCAD part layouts of selected model, (a) 6 parts cut from 12 mm thick OSB panel, (b) 7 parts cut from 19 mm thick OSB panel, (c) 10 parts cut from 19 mm thick Plywood panel.

4 Methods

The software used for the optimization study on yield in this study was Platanie Version 7.0 Total Production Optimization (TPO) Wood Optimizer. All cutting parts for the model were prepared on AutoCAD. AutoCAD part layouts were imported to the software. The software generated the best optimization of parts after number of frame sets and panel sizes were selected.

Factors

a. Effects of Layout Design

Optimize layout designs for each panel.
1219 by 2438 mm (4 by 8 feet) size panels were used.

b. Effects of Panel Size

Optimize layout designs for each panel.
Panel sizes that were used;
1219 by 2438 mm (4 by 8 feet)
1371 by 2438 mm (4.5 by 8 feet)
1524 by 2438 mm (5 by 8 feet)

c. Effects of Curved & Small Parts

Remove curved & small parts from the layout.
Optimize layout designs without those parts.

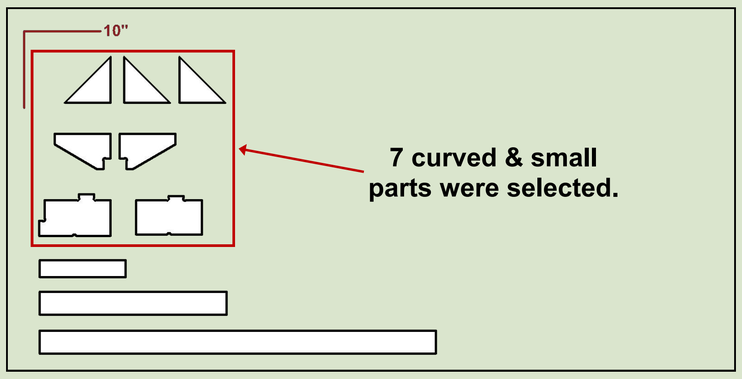

Figure 3. Selection of curved and small parts that might be effect the yield because of their shapes and their sizes in the red line.

Current Cutting Process

Table 1. Current material yield values for each type panel with number of panels were used.

Panels	Number of Using Panels	Yield %
12 mm OSB	48	73.94
19 mm OSB	24	84.44
19 mm Plywood	4	59.39
Overall Material %		**79.80**

In general, overall material yield was **79.80 percent by cutting 48 frame sets**. It means that **20.20 percent** of the panels was waste.

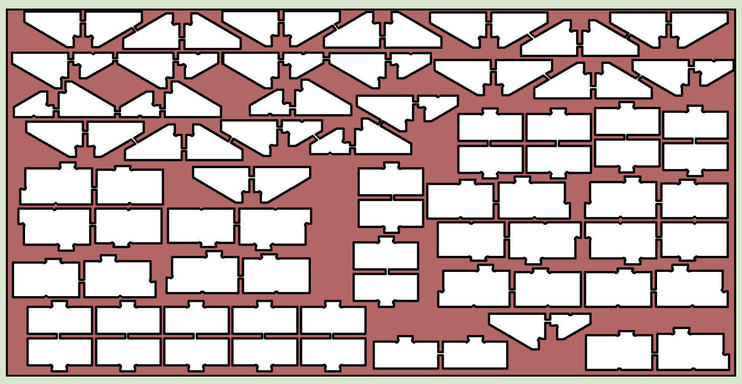

Figure 4. CNC layout that is currently used by the manufacturer for 19 mm plywood. (Red zones refer the waste of the panel and the value is **40.61 percent**).

5 Results

a. Effects of Layout Design

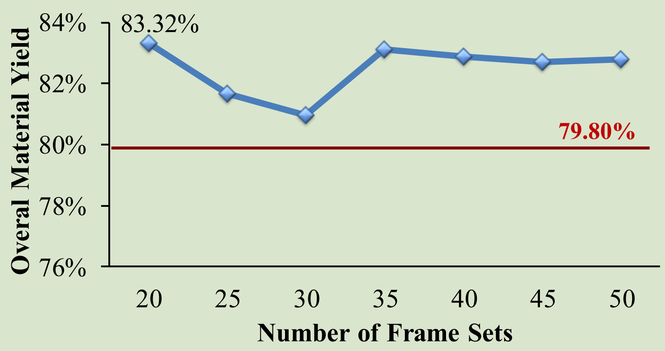

Figure 5. Overall material yield as a function of frame sets cut for 4 by 8 feet size panels.

b. Effects of Panel Size

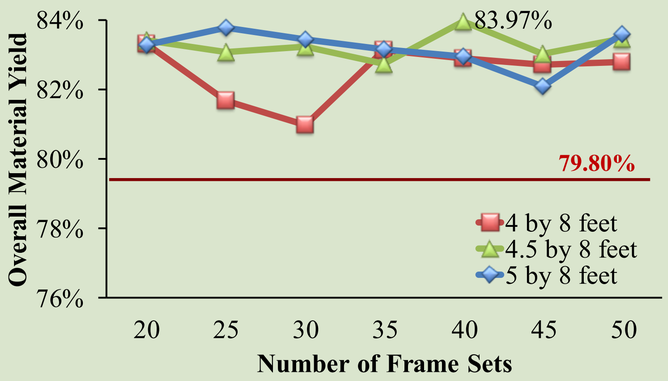

Figure 6. Overall material yield as a function of frame sets cut for different size panels.

c. Effects of Curved & Small Parts

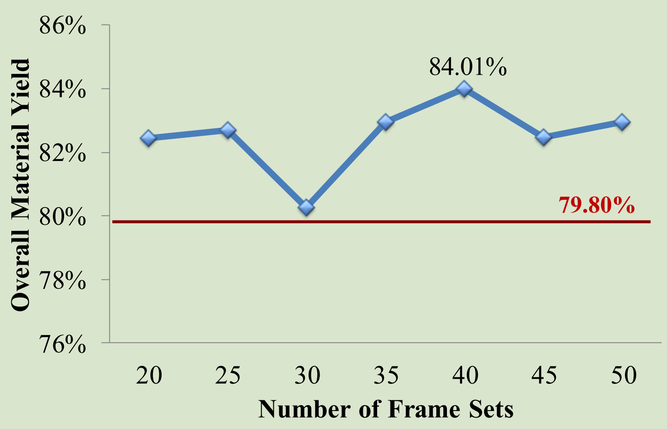

Figure 7. Overall material yield as a function of frame sets cut for 4 by 8 feet size panels without selected curved & small parts.

6 Conclusion

In this study, the material utilization efficiency in terms of cutting yield for a furniture frame model from a local upholstery company was evaluated using computer simulation software with optimization capacity. The overall material cutting yield obtained with simulation software can reach the range from 80 to 84 percent, which was higher than the current yield of 79.80 percent from the company.

7 References

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