FINAL REPORT

ASPEN FOR FINE FURNITURE

By

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SUMMARY

Aspen is an important part of the Minnesota sawmill industry with 100 million board feet sawn annually. Aspen lumber is primarily used to make low valued products such as pallets or in low price and low strength construction. The better quality aspen, #1 Common & Better, lumber is generally combined with the medium quality lumber in these products. Aspen high quality lumber should be used to make high value products such as fine furniture.

The goal of this project was to solve the problems incurred when aspen is used to make high quality furniture. Aspen is perceived to be soft and weak, and difficult to finish. These perceptions are somewhat true. The results of this project show how Minnesota aspen can be used to make fine furniture, can be machined well, can be stained as well as painted while remaining an inexpensive hardwood.

This project was started using GMC funding. The work has been successful in that three of the four project objectives are well advanced. The fourth objective, determination of aspen hardening, was not started as it was of lower priority. In the work reported here, we have determined that if conventional joining is used, aspen furniture will have weak joints . A new technique to make aspen furniture parts with strong joints has been developed and this technique has been reduced to practice using state-of-the-art quality control and manufacturing. Prototype pieces of a ready-to-assemble (RTA) living room furniture design have been produced.

Future work in this project will consist of completion of the RTA living room furniture prototypes and determination of consumer acceptability through test marketing. The research into aspen hardening should be completed and is expected to result in a process that will speed up the naturally occurring aspen hardening.

INTRODUCTION

BACKGROUND

Aspen is an important part of the Minnesota sawmill industry with 100 million board feet sawn annually. Most of this lumber is used to make lower valued products such as pallets or is shipped out of state as low cost lumber. The high quality aspen lumber, #1 Common & Better, could more profitably be used to make fine furniture, i.e., adding value in Minnesota. Aspen is perceived as being cheap, soft, weak and difficult to machine. The results of this preliminary work show that Minnesota aspen can be used to make fine furniture, can be machined well and can be stained as well as painted, while remaining an inexpensive hardwood. The work to date has reinforced the need to study aspen hardening. The results show how to overcome challenges in making fine furniture from aspen but having hardened aspen will enlarge the furniture potential.

Minnesota aspen has been used for juvenile and for unpainted furniture, however as juvenile furniture quality and price increased, aspen was replaced with maple and alder, which are harder woods and more easily machined. But aspen continues to be used in making unpainted furniture. Ready-to-assemble furniture made from grain printed, paper overlaid particle board

has made substantial inroads into the unpainted furniture market. The markets for the highest quality aspen lumber have dwindled and much of that good lumber goes into products that do not need to be made of such high quality wood.

The project was research, development and market oriented. It was expected that a new technique to make aspen furniture parts with strong joints would be developed, and that the technology would be reduced to practice using state-of-the-art quality control and manufacturing. It was also expected that research into aspen hardening would be started.

A stepwise, learn as you go, procedure was followed. Each new furniture design brings in new challenges of quality control, design (CAD/CAM) requirements, and marketing. Prototype furniture pieces in each design can be made, and the prototype pieces used in market acceptance testing.

PARTICIPANTS

Hedstrom Lumber Co., Grand Marais, Rajala Timber Co., Deer River, and Keewatin Sawmill, Keewatin collaborated in the sawmilling and kiln drying of aspen. Partridge River Co., Hoyt Lakes, Woodline Co., Eveleth, and AccuWood Ltd., Grand Rapids, collaborated in the making of parts and furniture. Minneapolis College of Art and Design, Minneapolis, and International Design Center, Minneapolis, is cooperating in the design and marketing of aspen furniture.

JUSTIFICATION

If only ten million board feet of the best quality (#1 Com&Btr) aspen lumber, ten percent of the total sawn annually in Minnesota, is made into furniture or kitchen cabinets the green lumber value of $2.5 million will be increased to $7.5 million as furniture parts or almost $14 million as furniture at wholesale. Using a figure of $100,000 of sales generated by each worker the $5.0 million value added in making parts from lumber could generate 50 jobs. The $6.5 million value added in making furniture from parts could generate an additional 65 jobs.

OBJECTIVES

The objective of this project is to make Minnesota aspen an important fine furniture hardwood. To meet this goal four research and development objectives were proposed:

1. Determination of timing and mechanism of aspen hardening.
2. Develop quality control programs for aspen parts & furniture making.
3. Develop CAD/CAM programs for aspen furniture manufacturing.
4. Develop aspen furniture manufacture and marketing expertise.

PROCEDURES

RESEARCH PLAN

The work was planned in several phases:

determine how aspen parts should be joined to obtain strong furniture from such a low density species,
test the joining system chosen by making furniture
test marketing this furniture
determine the mechanism of aspen hardening

Quality control procedures together with Computer-Aided-Design (CAD) and Computer-Aided-Manufacturing (CAM) techniques were expected to be developed to aid in the efficient manufacturing of the furniture.

We also expected that the aspen fine furniture developed in this project will encourage the manufacture of this furniture in Minnesota. These companies could buy completely machined parts from hardwood dimension companies in Minnesota. The dimension companies could obtain the high quality, kiln dried aspen lumber from existing Minnesota sawmills. NRRI has used this technique to aid futon bed makers in Minneapolis who buy parts made from Minnesota white birch by a NE Minnesota dimension company.

MATERIALS AND METHODS

High quality, #1 Common & Better, kiln dried aspen lumber was obtained from cooperating NE Minnesota sawmills.

The joining system used for making the aspen fine furniture was developed based upon the furniture engineering work done by Dr. Carl Ekelman of Purdue University. Dr Ekelmans' work is promulgated by the Society of Manufacturing Engineers (SME). After a suitable joining system was found, furniture designers and retailers were interviewed to determine the most appropriate type of furniture to be made. Prototype pieces of this fine furniture were built using NE Minnesota woodworking shops. These prototype pieces have been shown and test marketed by cooperating furniture retailers. The prototype furniture that finds a market will be used to get new furniture makers into Minnesota or to expand the existing Minnesota furniture companies.

The University of Minnesota, Duluth campus Industrial Engineering department is aiding in the application of CAD/CAM and quality control programs for the manufacturing of the completed parts from aspen lumber. The hardening of aspen research will be done as a masters project in wood technology at the university.

RESULTS AND DISCUSSION

After attending a SME furniture engineering short course given by Dr Carl Ekelman of Purdue University it was determined that aspen is too low in crushing strength to use any of the existing joining systems, such as dowel or mortise and tenon joints, to make aspen fine

furniture. We therefore developed a laminated part technique where wide, thin aspen pieces are laminated to make joined pieces. This technique permits the joints to have a wider cross section than the width of the pieces thereby giving a very strong joint. In conventional furniture making the parts are machined and then joined. In our technique the parts are laminated and then machined. State-of-the-art Computer Numerical Controlled (CNC) routers are used to machine the parts. Although the CNC routing of the parts is more expensive than conventional parts making there is no joining cost. The technique was reduced to practice with a stool of unique design, which is very light but testing showed that it can carry a 2,000 pound load.

After development of the aspen joining system expert advice was sought regarding the best type of fine furniture to make. Ready-to-Assemble furniture is the fastest growing segment of the furniture business. Aspen fine furniture would fit very well into the high end RTA furniture business. A Minneapolis interior decorating and furniture retailing company provided a set of specifications for an upholstered suite of RTA living room furniture. These specifications were:

Furniture should be modular, so that a chair, 2-seat, 3-seat, or 4-seat couch would be available
Furniture should be either sectional or one piece, and ready-to-assemble
Upholstery covers should be easily changed and not require professional reupholstering

NRRI designed a suite of furniture made from aspen which meets all of the specifications and called this the "Sand Lake Design". Since there is no RTA furniture on the market that meets all these specifications the suite is unique. A single unit (chair) of this design has been built.

The engineering department, University of Minnesota, Duluth campus has obtained Minnesota Advanced Manufacturing Technology Center (MAMTC) funds to help set up the Arrowhead Advanced Manufacturing Center (AAMC) in the seven county arrowhead region of NE Minnesota. We expect to use the capabilities of AAMC to determine the correct CAD/CAM procedures to be used in making the aspen fine furniture commercially. Two NE Minnesota hardwood dimension producers will cooperate in this work.

The goal of this project was to provide the knowledge and experience necessary for the use of 10 million board feet of high quality aspen lumber for the manufacturing of fine furniture. Such a furniture industry would create 50 jobs in making completed parts from lumber and 65 jobs for making furniture from these parts. At the present time the first project funding is exhausted and in order to accomplish this goal additional funding is needed.

It is hoped that the new AAMC will provide the opportunity to make use of the newest CAD/CAM techniques and quality control methods for making aspen fine furniture in Minnesota. The prospective furniture maker need not invest in woodworking equipment but will buy the completed parts from NE Minnesota hardwood dimension manufacturers.

CONCLUSIONS

We have determined that conventional furniture design and joining is not applicable in making fine aspen furniture. A new system for making strong fine aspen furniture has been developed and has been reduced to practice. Prototype work has shown that light yet very strong furniture can be made using aspen.

The aspen furniture can be made using state of the art equipment available in Minnesota.

We have determined that high end RTA furniture gives the best promise for aspen fine furniture. A suite of RTA living room furniture of unique design has been reduced to practice.

RECOMMENDATION

While this work is well advanced it is not to the point of commercial application. The current proposal for continuation of this project should be funded by GMC to insure that the promising commercialization of the NRRI research, development and marketing work will succeed. At least two additional RTA furniture designs can be completed with the requested funds.