Department of MECHANICAL ENGINEERING
THE UNIVERSITY OF UTAH

Log Lathe Modernization

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Wasatch Timber Products
MILLED LOGS HAND PEELED LOGS
ROUGH SAWN TIMBERS FENCING

INTRODUCTION

Wasatch Timber operates a large-scale log lathe that debarks and cuts logs up to 28 inches in diameter and 32 feet in length. After over 40 years of operation and significant reliance on manual labor, Wasatch Timber commissioned us to modernize their machine.

PROJECT SCOPE

The modernization of Wasatch Timber's log lathe aims to expand product offerings, reduce labor time, and enhance adaptability for future needs. A wider range of products is accomplished by reducing the headstock size, while components have been designed for easy replacement or modification. Labor reduction is achieved by replacing manual operations with electric actuators and installing new clamping systems using heavy-duty toggle clamps. Our primary objectives can be seen below:

- Increase diameter cutting capacity
- Replace manual operations with electronic actuators
- Installation should be easily modifiable/repairable
- Simple controls/operation

Primary Metric	Required Value	Result	Units	Metric Application
Minumum Cutting OD	6	6	in	Headstock
Maximum Cutting OD	20	24	in	Headstock
Maximum Load	4269	>4269	lbf	Headstock
Cutting Diameter Increment	1/2	1/100	in	Actuation
Cutting Diameter Precision	1/16	1/25	in	Actuation
Minimum Vertical Load	300	1124	lbf	Actuation
Minimum Horizontal Load	400	1124	lbf	Actuation
Clamping Force	1000	2000	lbf	Trolley
Safety Shielding	-	✓	-	Trolley
One Headstock For All Log Sizes	-	✓	-	Headstock
Single Button Reset/Disengage	-	✓	-	Actuation

Table 1: Primary objective metrics

MODAL ANALYSIS

A modal analysis of the trolley frame was conducted to assess potential vibrational concerns affecting the machine's longevity. The analysis revealed six vibration modes below the motor frequency of 60 Hz. However, due to the brief time motors operate at each frequency and the lathe's current functionality, stiffening the trolley frame was deemed unnecessary.

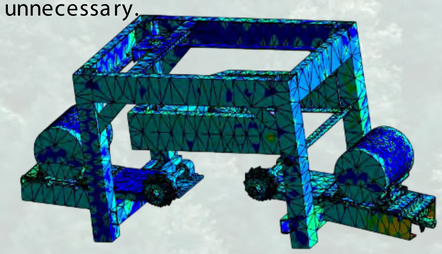

Fig. 1: ANSYS model of trolley frame

Mode	Frequency [Hz]
1	24.571
2	25.629
3	33.897
4	36.717
5	45.812
6	46.532

Table 2: Vibration frequencies

CLAMP MOUNTING

Destaco Model 527-F vertical pull toggle clamps were selected to replace the previous clamping system that relied on a single 1¼-inch bolt to be tightened with a 4-foot breaker bar. These clamps reduce labor and significantly speed up the sizing adjustment process. Each side of the trolley will have two clamps per side securing the rough cutter motor plates, providing a combined holding force of 2,000 lbs per side.

Fig. 2: Destaco clamps

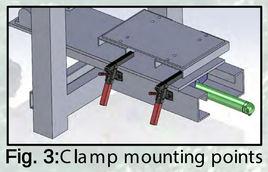

Fig. 3: Clamp mounting points

HEADSTOCK ASSEMBLY DESIGN

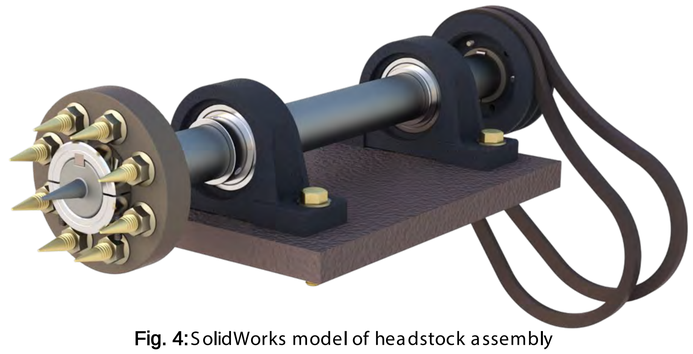

Fig. 4: SolidWorks model of headstock assembly

The final headstock design accommodates a broader range of log sizes, increasing diameter cutting capacity from 7–20 inches to 6–24 inches. It is rotated using two V-belt pulleys driven by a motor. The faceplate features nine teeth, including an extended center tooth for precise log alignment and optimal cutting performance.

HEADSTOCK ASSEMBLY ANALYSIS

- Safety factors were analyzed for shaft and bolt design parameters
- Mechanical performance was simulated using finite element analysis (FEA)
  - Expected max stress along shaft = 22.31ksi
  - Expected max stress along bolt = 59.80 ksi
- Analytical results were validated using FEA
  - 4.51% difference between analytical and FEA results for shaft
  - 0.12% difference between analytical and FEA results for bolts

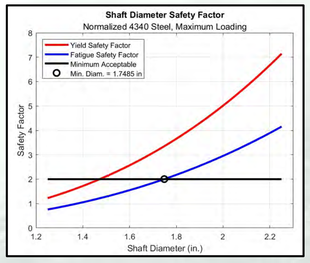

Fig. 6: Plot of shaft safety factors

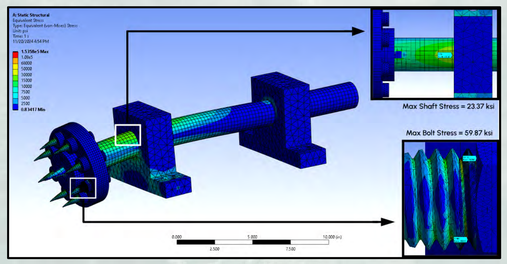

Fig. 5: Iso-view of equivalent (von-mises) stress

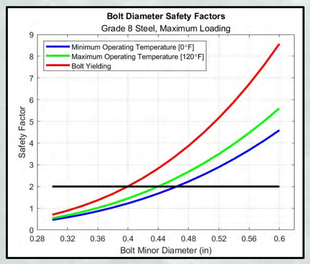

Fig. 7: Plot of bolt safety factors

HEADSTOCK DRIVE SYSTEM

The drive system was redesigned to increase torque and optimize power transmission, and a belt tensioner was added to prevent slippage in wet conditions such as rain and snow.

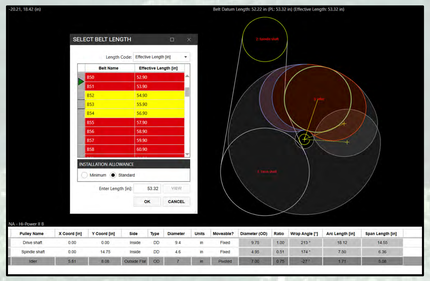

Fig. 8: Geometry of new drive system

ACTUATOR MOUNTING

Three linear actuators control the sizing adjustments: two 12-inch stroke actuators for the rough-cutter adjustments and one 18-inch stroke actuator for the finish cutter. Each actuator is mounted using welded brackets, consisting of a collar bracket and a pin connection bracket. Additionally, a custom welded mounting point was added to the trolley frame to mount the finish cutter brackets.

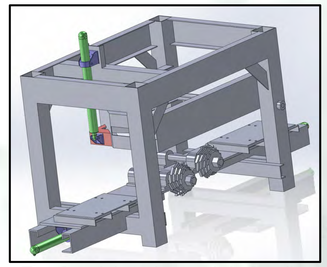

Fig. 9: SolidWorks model of trolley

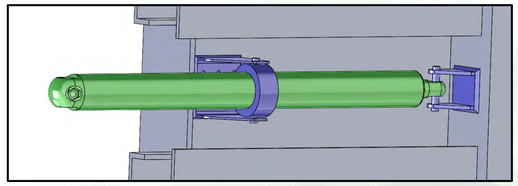

Fig. 10: Mounting points for horizontal actuators

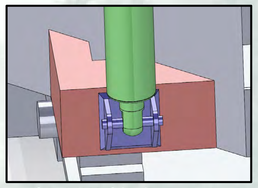

Fig. 11: Welded mounting point for vertical actuator

CONTROL CABINET

Each linear actuator is equipped with a Hall-effect feedback sensor for precise position control. The actuators can be operated individually or simultaneously using a rocker switch, reducing the time and labor required to adjust the cutting heads.

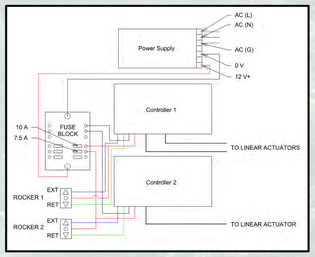

Fig. 12: Wiring Diagram

Fig. 13: Cabinet Layout

NEXT STEPS

After some delays in installation, the team will be heading on-site to install all designs between December 5-13. Installation will include: the control cabinet, all three actuators, the headstock assembly, and a belt tensioner. The clamps will be installed at a later date, separately by Wasatch Timber, due to delays in part shipping.

CONCLUSION

Given the project's scope, using thorough analysis on the updated designs for the Wasatch Timber log lathe showed our designs successfully met all the project objectives. The final headstock design accommodates a broader range of logs while being easy to modify and repair. The selected actuators exceed precision and accuracy requirements, and the chosen clamps reduce labor demands while enabling more efficient adjustment speeds between log size changes.