Precision Automated Ski Sidewall Router

Team: Nur Hidayah Ayoep, Brian Durkee, Jahaziel Lara Hernandez, Josh Lyman, Brock Rose
Advisor: Dr. Kam Leang

Project Introduction
This project is a collaboration with DPS Skis company, a local Utah ski manufacturer. We are developing a machine that can replace the existing manual routing process of ski sidewalls. When skis are being manufactured, there is a step in the process in which the sidewalls of the ski have to be routed so that they are at an angle, or a chamfer, rather than perfectly vertical. Currently, this process is done by hand. This results in production inefficiencies, largely due to human error, causing the skis to be scrapped.

Project Goal
The main goal of this project is to design an automated process to trim the ski sidewalls. It will reduce manufacturing error, reduce scrap rate, and training costs that result from the manual handheld routing process.

Design
Collaboration with DPS engineers addressed objectives and target metrics that resulted in an optimized design.

• Overhead Pistons Assembly – Actuates pistons to flatten the ski and hold it in place.
• Gantry System – Dual acting pistons engage the routers. Pistons and guide rails create motion in order to follow contour of ski without programming each ski profile.
• Ball Screw Actuator and Guide Rails – Creates and limits motion along the length of the ski or snowboard.
• Frame Assembly – Extruded Aluminum with casters for mobility.

Table Beam Analysis
Goal: Deflection in the beam of less than 1 mm with twice the required weight to eliminate ski camber.
• 20 lb. of force spread among 4 points required to eliminate the ski camber.
• FEA shows a deflection of 0.36 mm when applied with forces required to eliminate the camber.
• Applying a factor of safety to 2 to the load results in a deformation of 0.72 mm

Gantry Analysis
Goal: Determine the size and type of piston
• Calculations using F=P*A for the force outputs.
• 1st Piston: 1.5" bore, single acting, spring return piston. By using comparisons between the force output of the piston and the calculated force we determined the spring return caused excessive inconsistencies. The piston didn’t provide the constant force that was desired.
• The piston was replaced with a 1-1/16" bore double-acting piston to reduce force inconsistencies and work more reliably at smaller pressures.

Ski profile view with sidewall highlighted

Final Design CAD Model

Project Conclusions
CAD model addresses the goals for this prototype project.

• Automates the process reducing training costs and operator error.
• Piston system to engage routers eliminates extra programming and complexity.
• Constraints movement to 2 degrees of freedom eliminating possibility of gouges resulting in scrapped skis.
• Over 90% off the shelf parts allows for ease of assembly and maintenance.

Future Work
• Build physical mechanical assembly and integrate electrical components to automate process.
• Test speeds and feeds that will produce quality surface finishes.