Research, Force Analysis and Ski Modeling to Inform Ski Design Optimized for Telemark Skiing Versus Alpine Skiing

Student: **Ryszard Olszewski** (Honors Capstone)
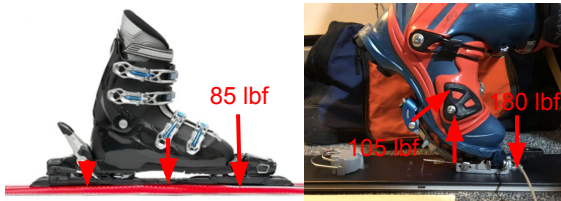Advisor: **Michael Umbriac**

Motivation

- Telemark skiing imparts **different forces** on a ski compared to alpine resulting in **performance discrepancies**.
- Using telemark bindings **voids ski warranty** due to bindings often **tearing out**.

Problems and Why They Occur

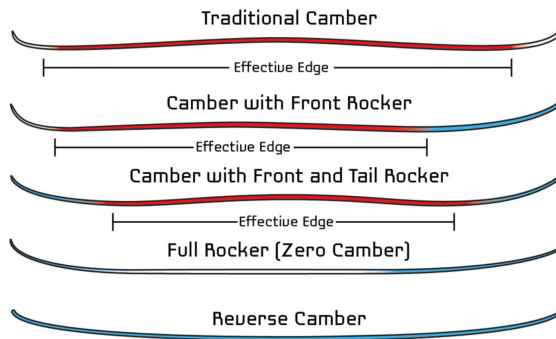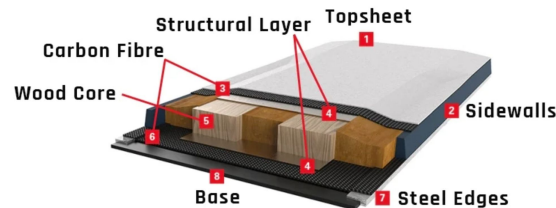Different forces place on the ski during a turn.

Alpine — 85 lbf

Telemark (trailing) — 105 lbf, 180 lbf

- Back of the trailing ski is **unstable** and sometimes **lifts** due the heel lift pulling up on the back of the binding.
- **High forces** in small area, especially around pivot point, can **tear out** the binding in **weaker core skis**.
- Ski is not **curved as designed** for both leading and trailing skis due to either **too much or too little force**.

Jessica. (2015, November 18). *Camber and Rocker -*. Ski Brule. https://skibrule.com/camber- rocker/
Ski Construction Explained: What Are Skis Made Of? (n.d.).https://snowlink.com /ski-construction/
Skiing Equipment Isolated On Pure White Stock Photo 18014386. (n.d.). Shutterstock. Retrieved April 11, 2023,from https://www.shutterstock.com /image-photo/skiing-equipment-isolated-on-pure-hite-18014386
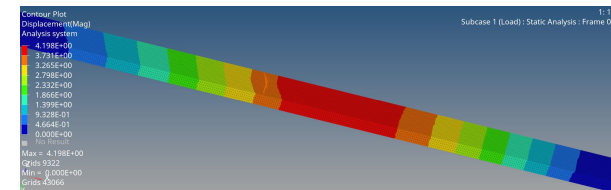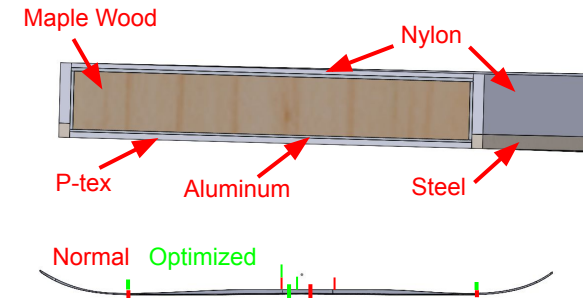
Common Ski Design

Aspects of interest include ski layering and ski shape.

Topsheet 1
Structural Layer
Carbon Fibre
Wood Core
Sidewalls 2
Base
Steel Edges 7

Traditional Camber — Effective Edge
Camber with Front Rocker — Effective Edge
Camber with Front and Tail Rocker — Effective Edge
Full Rocker (Zero Camber)
Reverse Camber

Methods

- Researched **materials** used and why to optimize **inherent ski properties**.
- Collected **real life force data** using pressure and spring scales to be used in ski **analysis**.
- Created skis in **SolidWorks** changing **camber shape** and the shape and length of the **structural layer**.
- Analyzed models in **Finite Element Analysis** to create stress profiles.

Optimizations

Maple Wood, Nylon, P-tex, Aluminum, Steel

Normal   Optimized

Future Work

- Expand real life force measurement to maximize model accuracy.
- Perform further experiments related to core cross-section shape.

Acknowledgements