

Michigan Technological University

Breaking Trail for Efficiency: Enhancing the Polaris Switchback

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Josh Ball
Andrew Wichlacz



Design Intent:

- Reduced Noise
- Reduced Emissions
- High Efficiency
- Cruising Speed of 45 MPH
- Comfortable to Ride
- Improved Handling
- Reduced Weight
- Marketable for all riders



Key Features

Noise Treatments

Increased Rider Comfort

Hi-Compression Weber 750cc

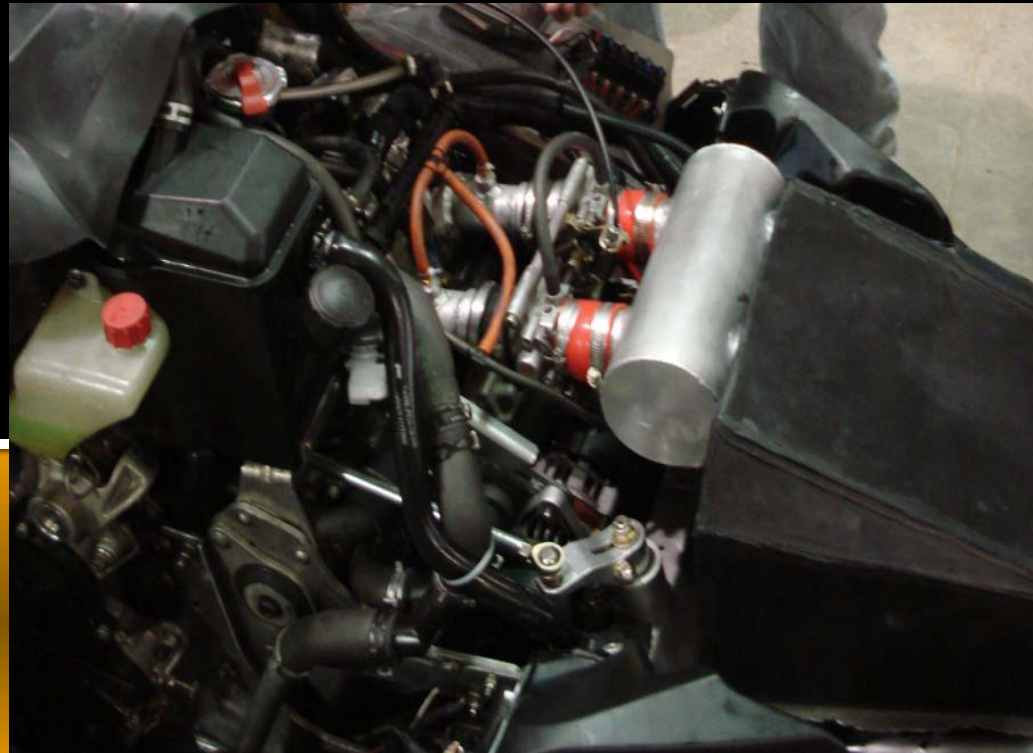


Progressive Rate Rear Suspension

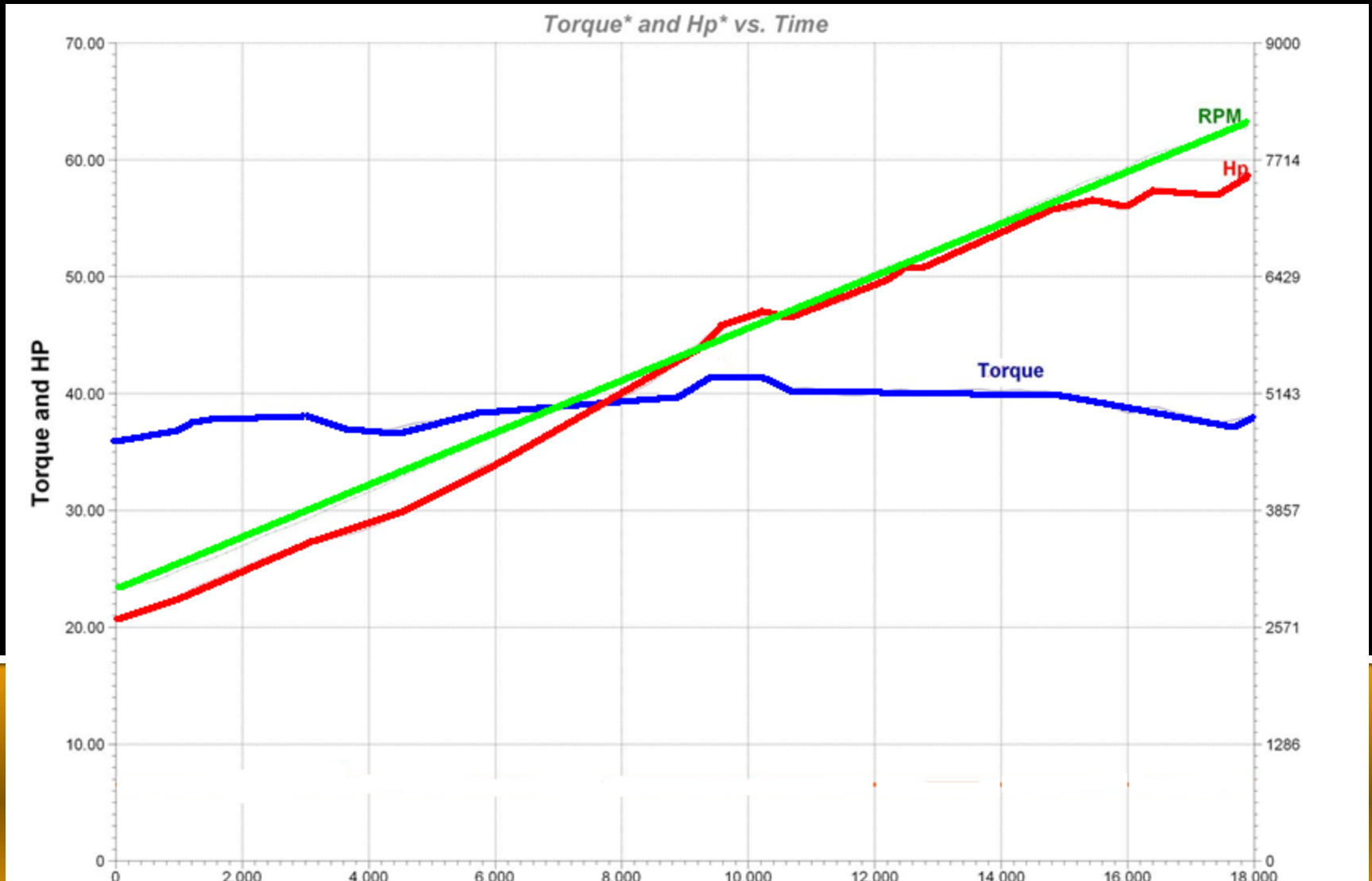
Increased Drive-train Efficiency

Engine

- 180° Rotated Head
- 11.5 : 1 Compression Ratio
- MTU Designed Intake Plenum
- MTU Designed Airbox
- AEM Engine Management System
- 55 hp with 43 ft-lbs torque



Engine Performance



Plenum Design

Design Goals

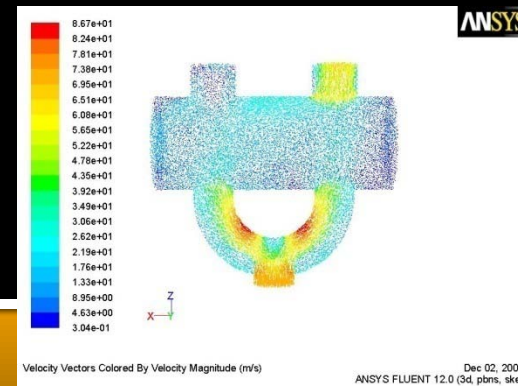
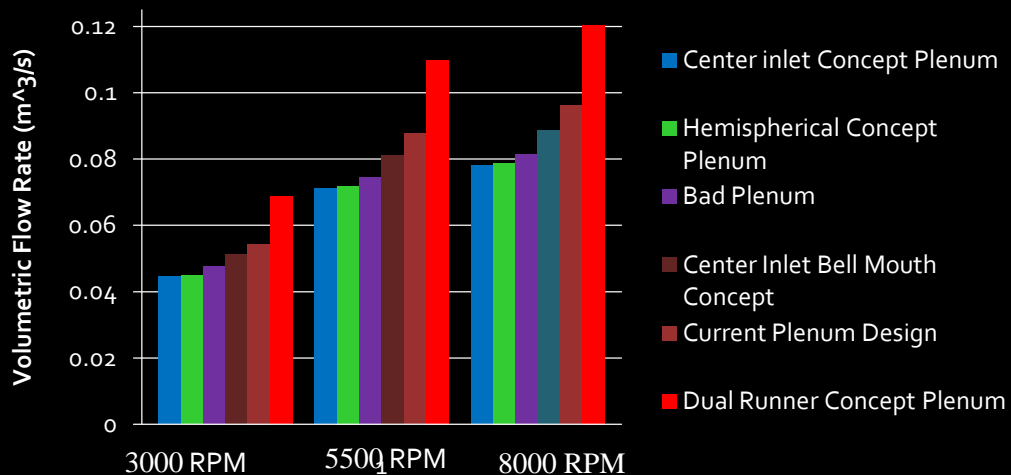
- Laminar Air Flow
- Equal Flow Between Cylinders

Design Evaluation

- Flowbench Baseline models
- GT Power engine models
- Fluent CFD



Average Volumetric Flow Rate (M^3/s)
vs. Engine Speed



Reduced Emissions

- E2x Fuel
- V-converter 3 way Catalysis
- Precise Fuel and Ignition Tuning

	Stock FST Emissions			2010 Entry Emissions		
RPM	HC (ppm)	CO (%)	NOx (ppm)	HC (ppm)	CO (%)	NOx (ppm)
1800	82	1.3	74	0	0.03	6
3000	801	1.11	2328	0	0.34	8
4000	387	2.23	1460	0	0.72	13
5000	327	5.02	775	0	0.97	15
6000	93	4.93	722	3	0.45	39
7000	58	5.46	646	10	2.00	88

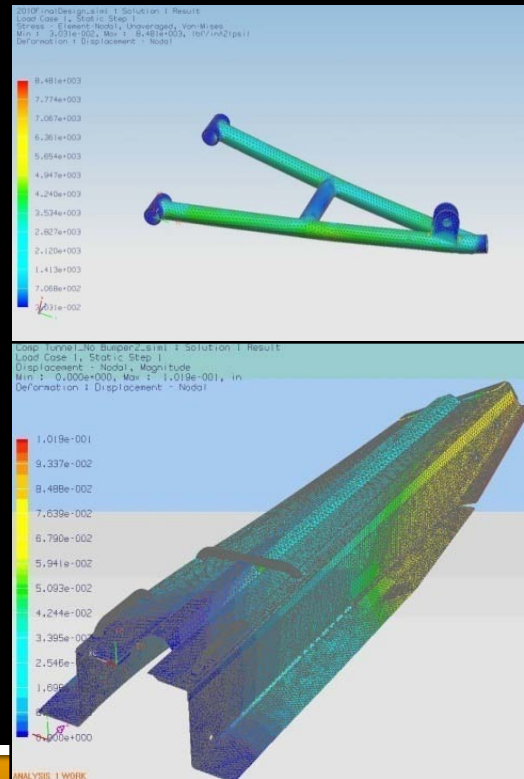
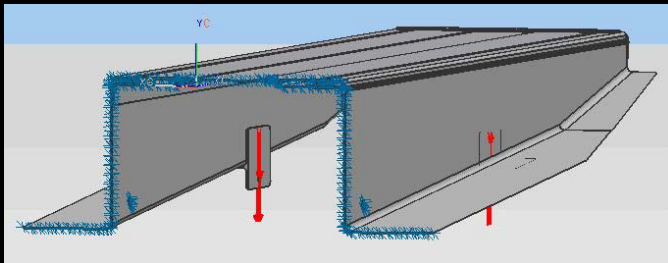
Chassis

- Rider forward ergonomics
- Seat and tank lift
- Rear Mount Exhaust System
- MTU designed front suspension A-arms
- Ski-doo SC 5 Rear Suspension
- Aluminum front and rear bumpers



Modeling

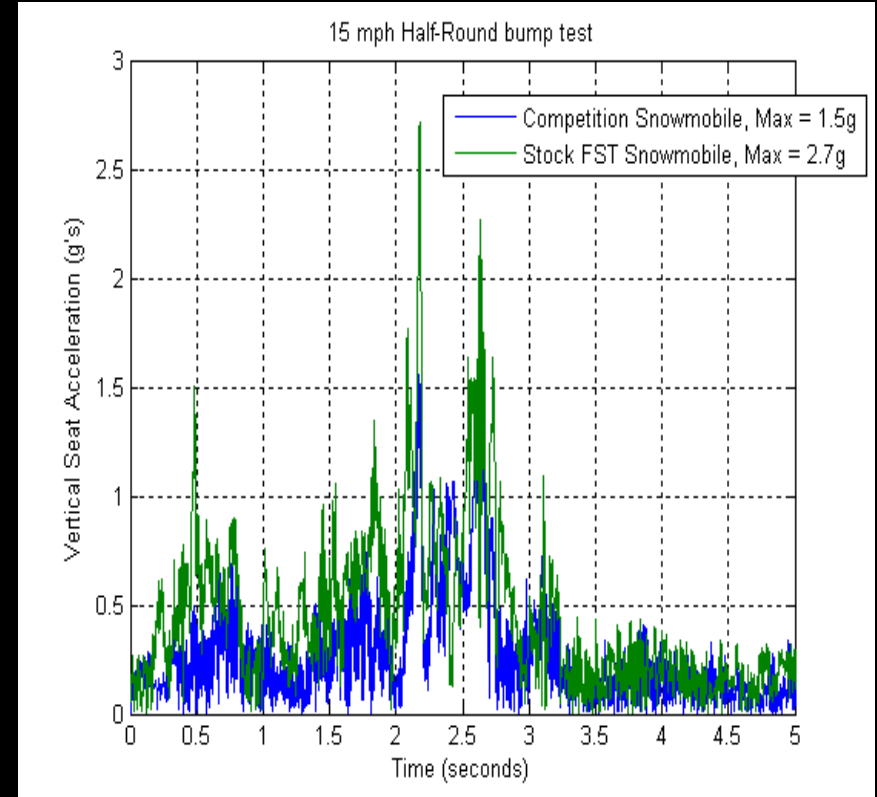
Tunnel Verification A-Arm Design and FEA



Tunnel Deflection
Stock .1020"
MTU .1019"

A-Arm Deflection
Stock .023" MTU
.0069"

Suspension Selection



Handling, Shock Absorption and Rider Quality:

Polaris M-10 = 48

Ski-doo SC-5 = 83

Optimized Efficiency



- Team Tied Driven Clutch
- 2.86 Drive Pitch
- Graphite Slides
- Multiple Rear Boggy Wheels
- Single Ply Cobra track
- Reduced injector size
- Intake Plenum
- Weight Reduction

$$\text{Fuel Flow (Lb/Hr)} = \frac{\text{Power} * \text{BSFC}}{\text{\# of Injectors} * \text{Duty Cycle}}$$

Public Marketability

- 15-17 MPG
- Low Maintenance
- Low Noise
- Rider Forward Ergonomics
- Comfortable
- Improved Handling
- \$13658.25 MSRP



Conclusion



- Fuel efficient
- Easy to operate
- Comfortable to ride
- Low maintenance
- Reduced emissions
- Low noise

Questions??

