SAE Shell Eco-marathon

Project Proposal

Team 14 A

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Overview

- Problem Statement and Client
- Concept Generation and Selection
- Engineering Analysis
- Engineering Economics
- Project Update
- Conclusion

Problem Statement and Client

Design a vehicle that maximizes fuel efficiency for the Shell Eco-marathon competition.

Client

- Society

Competition Information

- Competition hosted by Shell
- Capstone project representing SAE NAU

Technical Advisor

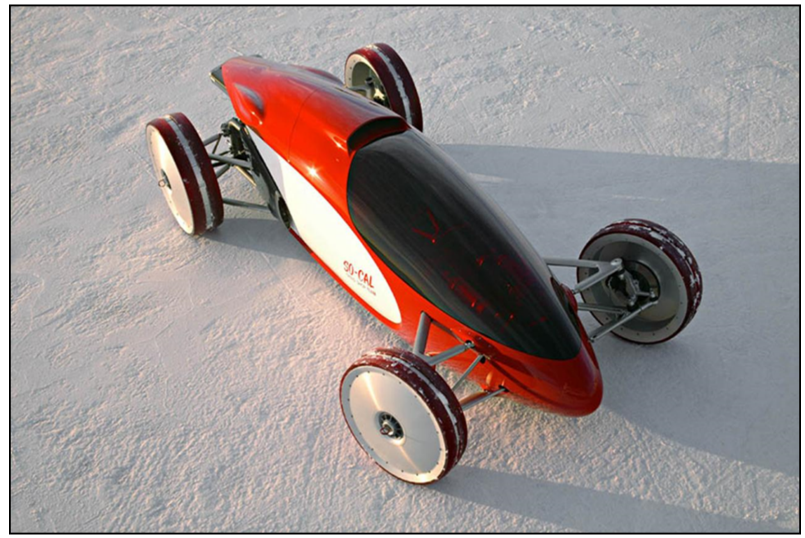
- Dr. Tester

Fairing Concept Generation

1. Streamlined open wheel
2. Streamlined enclosed wheel
3. Semi-streamlined / flat floor

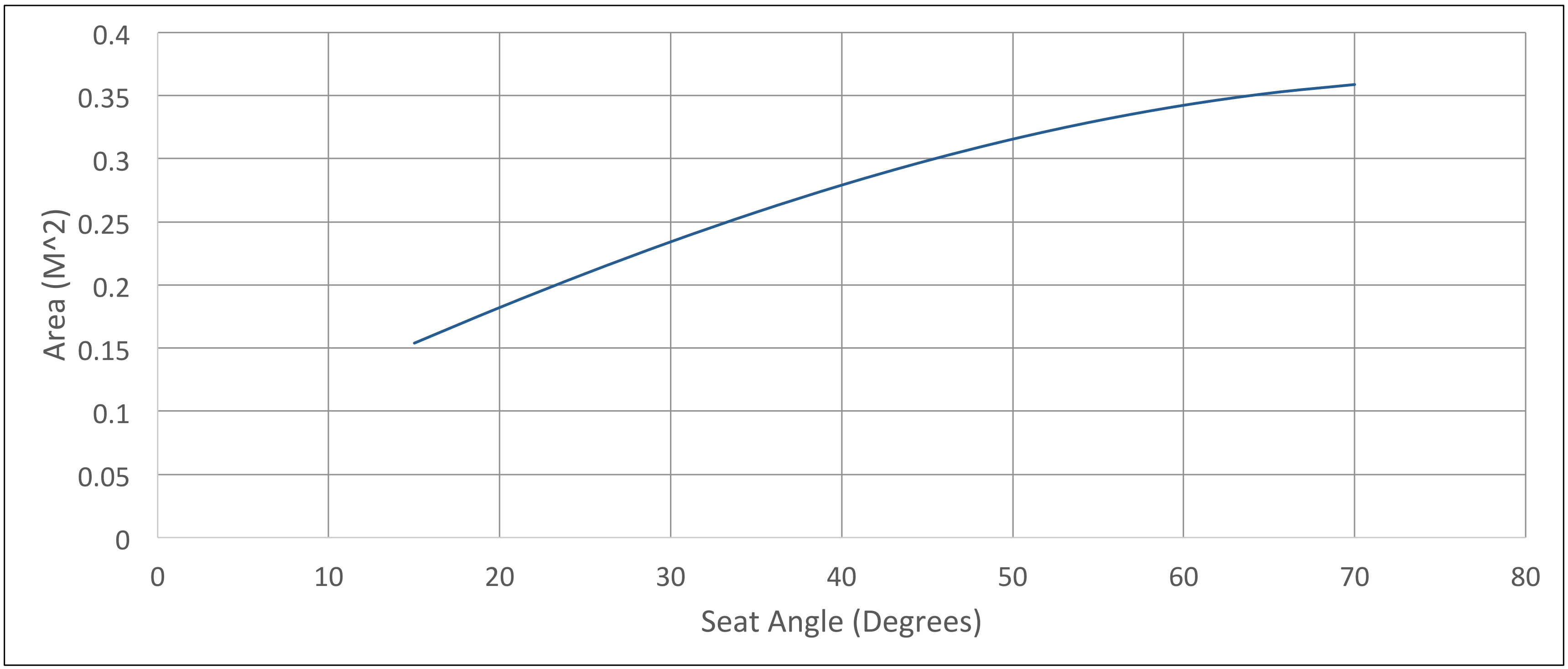
Decision Considerations

1. Cost and material availability
2. Available tools and facilities
3. Component selection

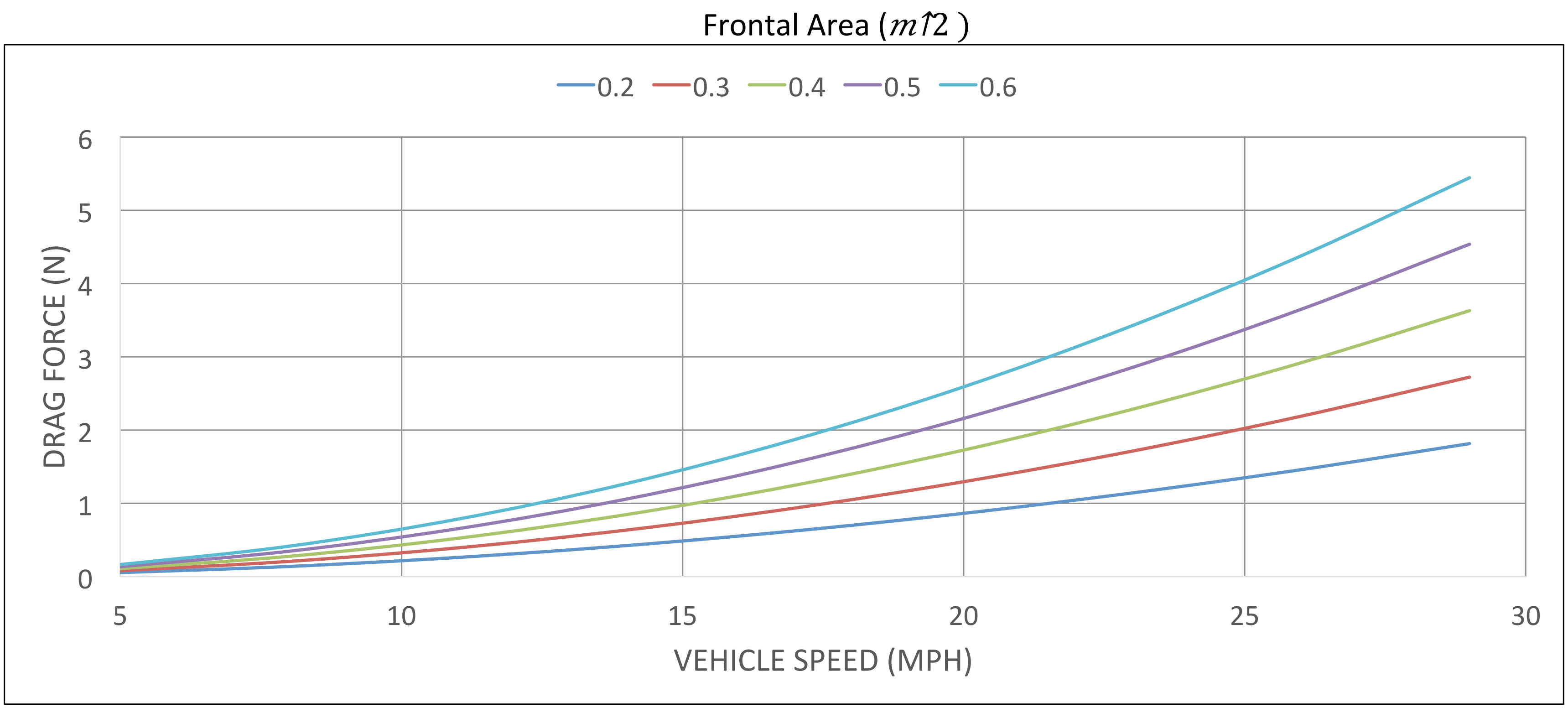


http://www.autoconcept-reviews.com/cars_reviews/gm/GM-belly-tank/cars_reviews-gm-belly-tank.html

Frontal Area/Seat Angle



Aerodynamic Drag



Chassis Analysis

Drag force

$$F_D = \frac{1}{2}\rho v^2 C_D A$$

Chassis rigidity

- Max deflection

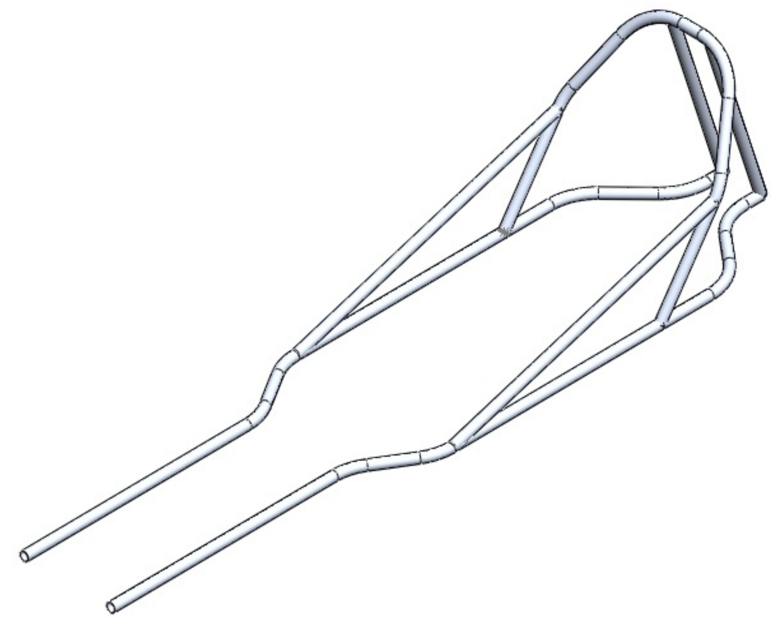
$$\delta_{max} = \frac{Fa(L^2 - a^2)^{3/2}}{9\sqrt{3}LEI}$$

$$x = \sqrt{\frac{L^2 - a^2}{3}}$$

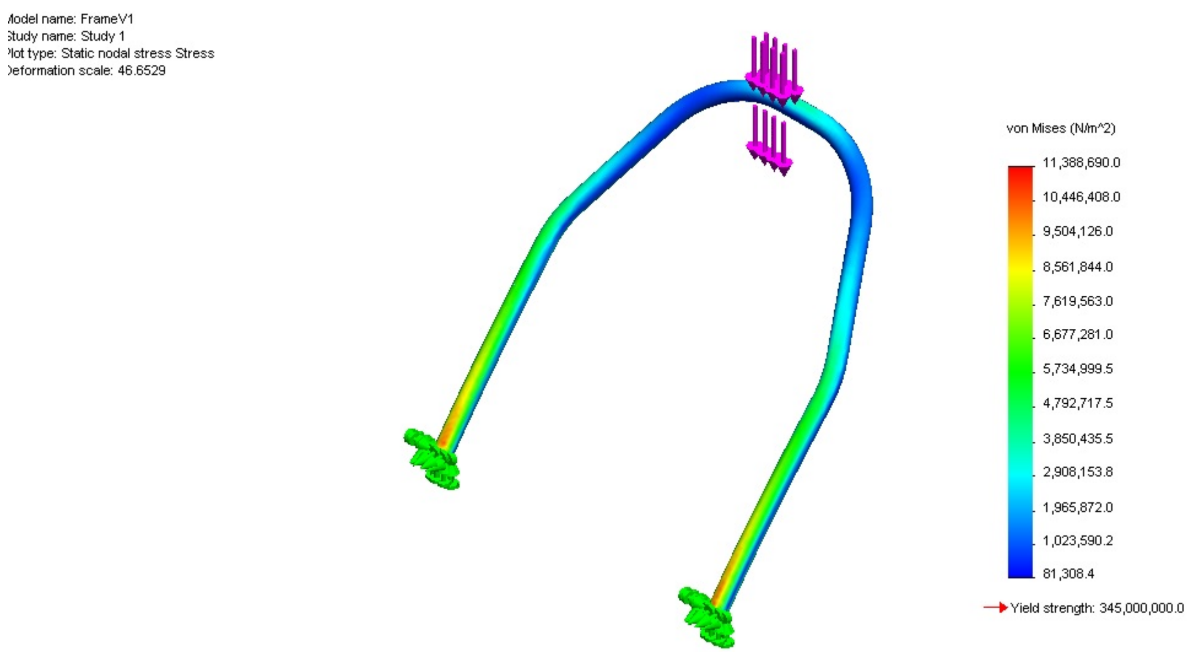
Variable	Value
a (Load to nearest support)	.6 m
L (Wheelbase)	2.5 m
X (Point of maximum deflection)	1.484 m
E (Elastic Modulus)	141 GPa
I (Moment of Inertia)	.079 m^4

Load at a	Maximum deflection at x
60 kg	1.19 mm
90 kg	1.78 mm
120 kg	2.37 mm

Frame Design



Roll Bar Loading



Chassis/Fairing Cost

Part	Date	Part Number	Supplier	Price
1.00X.083 Aluminum Round Tubing		26941.1	Online Metal Supply	$150.00
Floorboard Brackets		SWPart: FloorboardBracket	Qty.Required 15	$60.00
Flooring Material/Panel Inserts	Shipping Jan. 2014	Carbon Floorboard/Nomex Honeycomb Core	AirTraining Group	

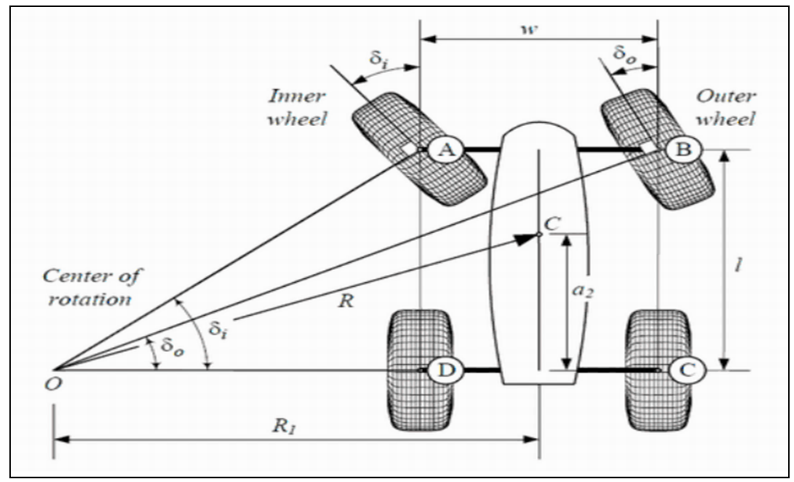
Steering Analysis

Ackermann Steering Geometry

$$R=\sqrt{a^{2}+l^{2}\cot^{2}\delta}$$

Rolling Resistance

$$F=C_{rr}N$$



Steering Costs

Part	Part Number	Supplier	Price
Steering Rack			$90
Rims			$210
Front Tires			$158
Rear Tire	Michelin 44-406 Prototype	ecomarathonamericas@shell.com	$79.00
Tubes			$60.00

Braking Concept Generation

1. Disk Brakes
2. Caliper Brakes
3. Drum Brakes

Decision Considerations

- Weight
- Cost
- Simplicity

http://upload.wikimedia.org/wikipedia/commons/2/21/BrakeDiskVR.JPG

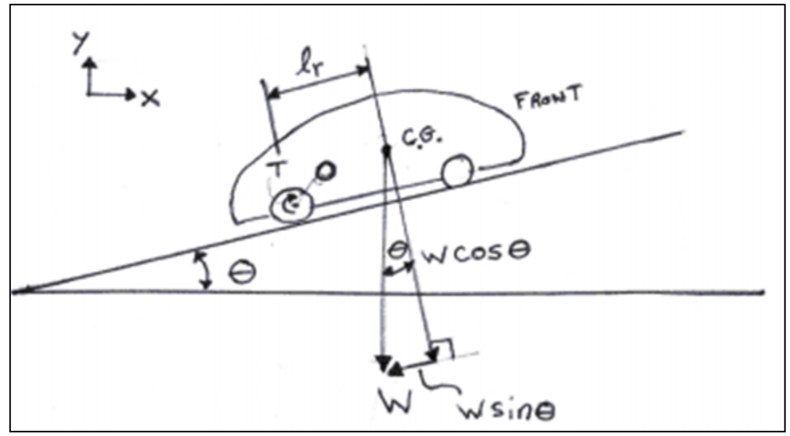
Braking Analysis

Braking force

- Most mountain bike braking systems provide enough force

Coefficient of friction

- Braking system must hold vehicle at 20% grade slope



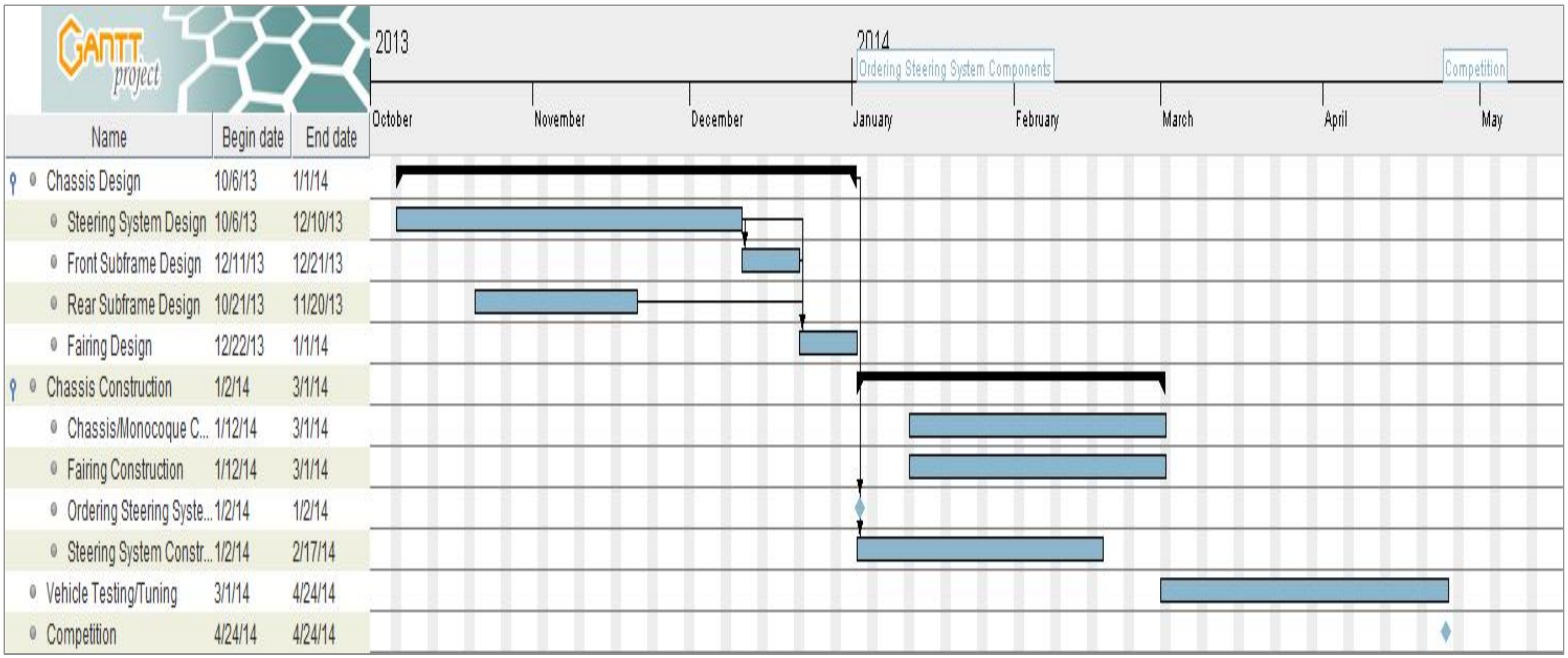
Braking Costs

Part	Price
Brake Rotors	$60.00
Brake Calipers	$150.00
Brake/Throttle Caliper	$40.00

Safety Equipment Costs

Part	Supplier	Price
Fire Suit	GForce	$130.00
Helmet	GForce	$150.00
Gloves	GForce	$65.00
20lb Fire Extinguisher		$115.00
2.5lb Fire Extinguisher		$30.00
5 Point Harness		$80.00

Shell Eco-marathon Project Timeline



Conclusion

- Chassis design is currently being finalized and component suppliers are being chosen.
- Costs will be minimized by soliciting tax deductible donations from local or regional suppliers, as well as using components available from previous NAU Eco-marathon vehicles.
- Braking system components are designed and ready to be ordered and applied to car.

References

- B. Jawad, E. Marck, D. Tingley, T. Salvati, J. McCoy, A. Ondes, E. Posta, V. Floma. "Best Practice for an SAE SUPERMILAGE Vehicle, " 2001-01-2469, SAE International, Costa Mesa, CA, 2001.
- J. Walker, Jr., "The Physics of Braking Systems" (1st Ed.) http://www.stoptech.com/docs/media-center-documents/the-physics-of-braking-systems, 2005.

Questions