

Air Flow Unlimited

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Intro

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- Airfoil structure analysis
- Airfoil force calculations and material selection
- Shape evaluation for the carts
- Spring selection and material choices for the carts
- User interface preliminary design

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Air blower

Air flow rate is 310 cubic feet per minute.

Gives 40 miles per hour air flow at the exit.

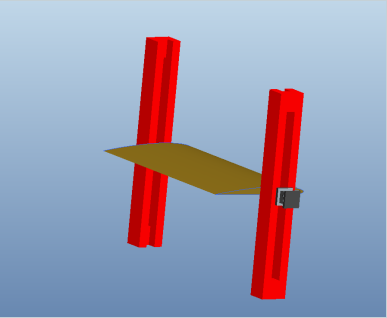
2 Blowers in total run off of a 120 AC outlet.

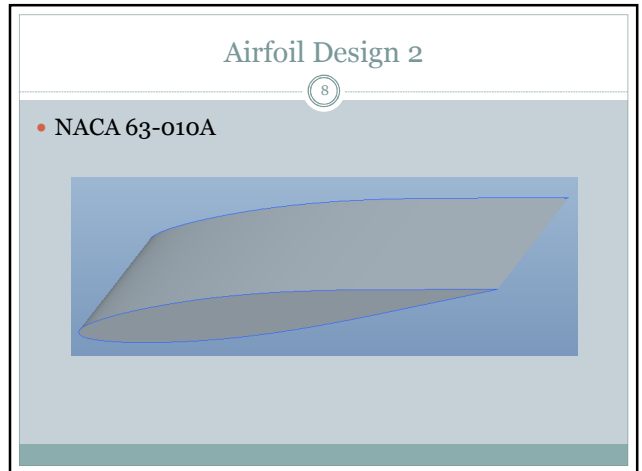
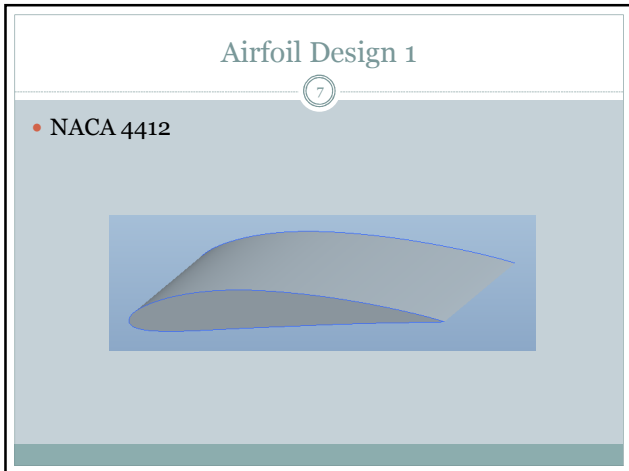
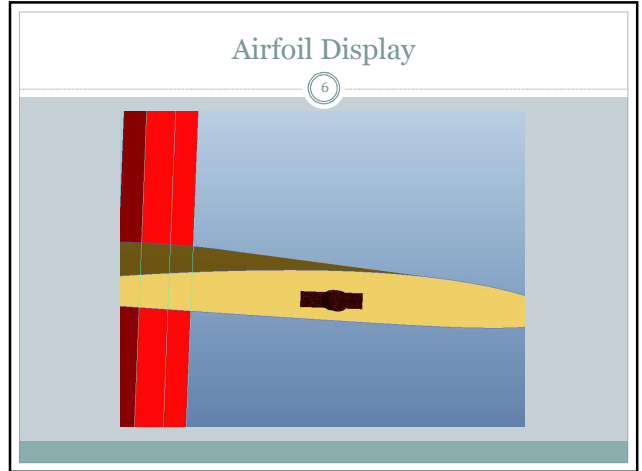
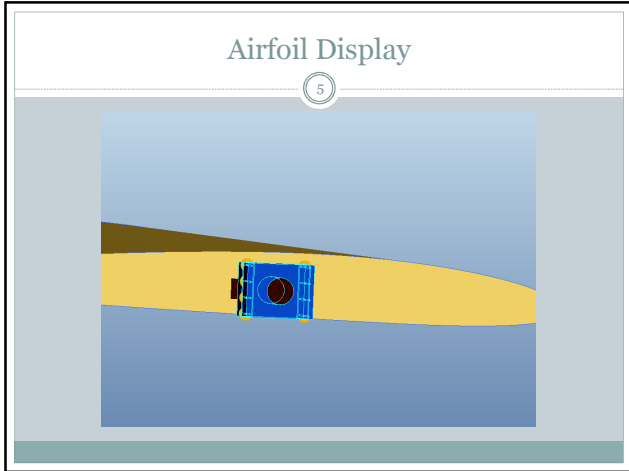
Further evaluation will be used to get the best approximation of the air speed at specific points in the display.



Airfoil Display

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Airfoil Design 3

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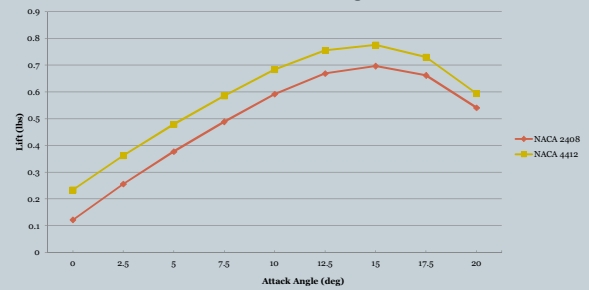
- NACA 2408



Lift

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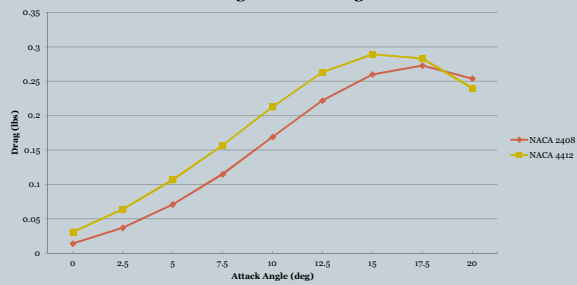
Lift vs. Attack Angle



Drag

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Drag vs. Attack Angle



Comparison

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NACA 2408

- Max. lift ~0.7
- Max. Drag ~0.27
- Smaller surface area
- Simpler shape

NACA 4412

- Max. lift ~0.78
- Max. Drag ~0.3
- Larger surface area
- Slightly heavier

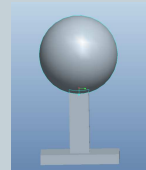
Airfoil Material

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- Combination of materials
- Hollow Center
- Carbon Fiber (CFRP)
- Balsa
- Bamboo

Carts Attachments

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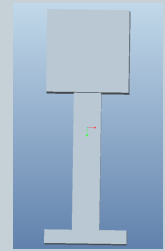


- Two attachments spherical, and square

• Drag force for a sphere with radius 2in. 0.7349 N

• Drag force for a square with sides 4in in length 2.09 N

• The cart only weights 226 grams so the attachments will be able to produce movement



Attachment materials

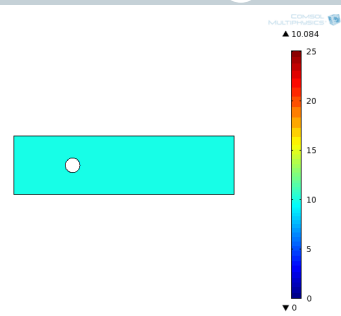
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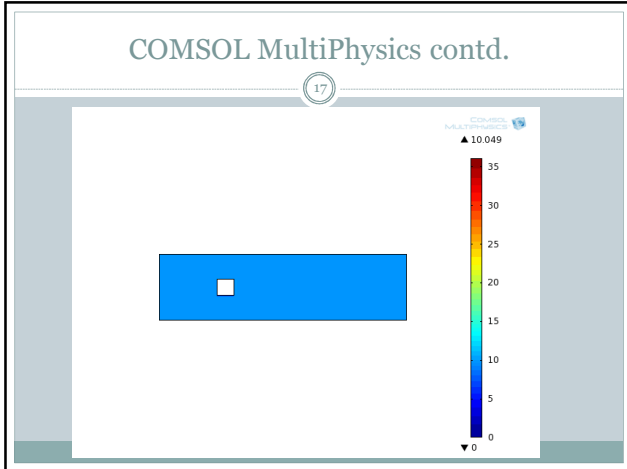
- light materials desired to optimize force produced
- polymer clay can be used to sculpt hollow designs
- Light weight and inexpensive

COMSOL MultiPhysics

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- Based on attachments
- Velocity profile
- Visualization of vortices
- Distribution of wake
- Display of drag



Spring

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Part Number	Outside Diameter	Wire Diameter	Max Load	Free Length	Rate	Max. Length	Initial Tension	Material
EI 600A 00 M	1.620 mm	0.203 mm	2.001 N	15.875 mm	0.09 N/mm	34.163 mm	0.177 N	SAE 304

- For the max force of 2.09N this spring will provide adequate movement
- usable for both circle and square carts

Display Potentials

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For both mechanical displays there will be an independent control and monitor.

Robust designs for both are a must.

Potentiometers instead of buttons or switches are safer, and limit the input.

Monitors instead of touch screens for a cheaper and safer alternative.

Future

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- Motor selection after final choices of materials and formatting for carts and airfoils
- Configuration between control inputs and mechanisms
- Selection of hardware for display and user controls
- Measure the actual air speed and mass flow with a pitot-static probe
- Use COMSOL to evaluate the airfoil at different attack angles

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Questions

References

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- http://www.ae.illinois.edu/m-selig/ads/coord_database.html#N
- <http://www.grc.nasa.gov/WWW/k-12/airplane/foil3.html>
- http://www.leespring.com/browse_catalog.asp?runitOfMeasure=Metric&springType=E&partnum=&UnitOfMeasure=metric&specsCriteria=&subType=&isMIL=&pageNumber=2