SAE AERO PRELIMINARY PRESENTATION

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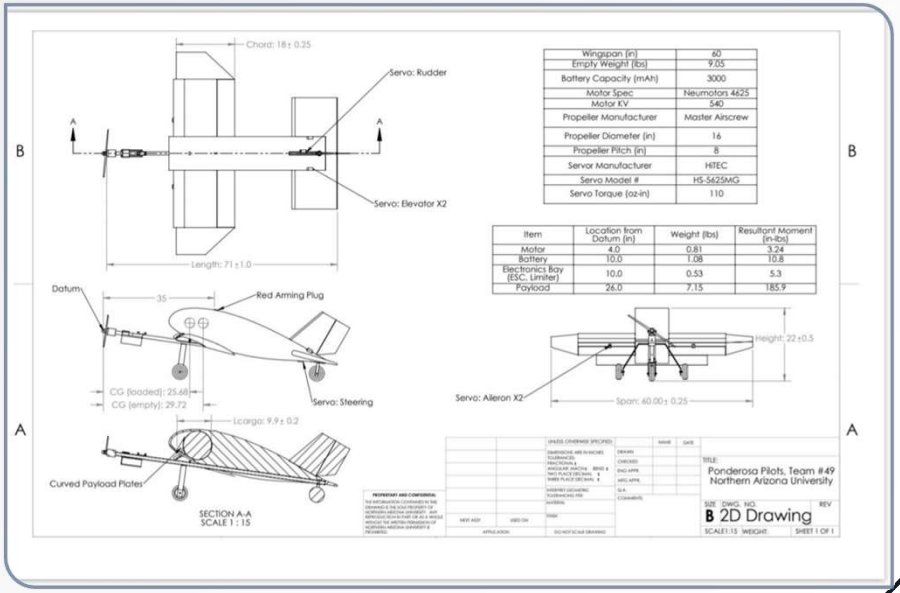
PROJECT DESCRIPTION

- SAE Aero Regular
  - Design a real-world aircraft to carry a payload
  - Deliver soccer ball payload
- The Regular Class
  - Is an all-electric class intended to develop a fundamental understanding of aircraft design.



Wingspan (in)	60
Empty Weight (lbs)	9.05
Battery Capacity (mAh)	3000
Motor Spec	Neumotors 4625
Motor KV	540
Propeller Manufacturer	Master Airscrew
Propeller Diameter (in)	16
Propeller Pitch (in)	8
Servor Manufacturer	HiTEC
Servo Model #	HS-5625MG
Servo Torque (oz-in)	110

Item	Location from Datum (in)	Weight (lbs)	Resultant Moment (in-lbs)
Motor	4.0	0.81	3.24
Battery	10.0	1.08	10.8
Electronics Bay (ESC, Limiter)	10.0	0.53	5.3
Payload	26.0	7.15	185.9

Image of NAU design last year [1]

SPONSOR

- Dr. Sarah Oman
- Mission statement
  - The challenge this year will be to analyze last year's design to determine how to optimize their system for flight and competition.
- Importance
  - Give team the ability to practice real world designs in a fun, competitive way
  - Challenges teams to create a functional aircraft in one calendar year

Our Sponsor [2]

BACKGROUND & BENCHMARKING

- All our background and benchmarking is going to come from previous projects and competitors.
- Top 5 winners form 2020
  1. University of British Columbia
  2. Penn State University
  3. Polish Air Force Academy in Dublin
  4. Embry-Riddle Aero University
  5. Alexandria University

WINNING DESIGN FROM LAST YEAR

REGULAR CLASS

Main Design Specifications/Limitations by SAE

Maximum Power Draw	1000 Watts
Maximum Wing Span	120 inches
Maximum Take-Off Distance	100 feet
Maximum Gross Take-Off Weight	55 pounds
Fibre-Reinforced Plastics?	No

2020 Winning Team's design [3]

**PLANES WERE NOT FLOWN SO THIS TEAM DID THE BEST WITH MEETING COMPETITION REQUIREMENTS

BENCHMARKING

- We are going to look at the following design and see what made them better then our NAU team (30th place)
- The other 3 teams did not have designs on their website
- This is most likely because they will reuse the design this year
- Penn State 2019 competition design

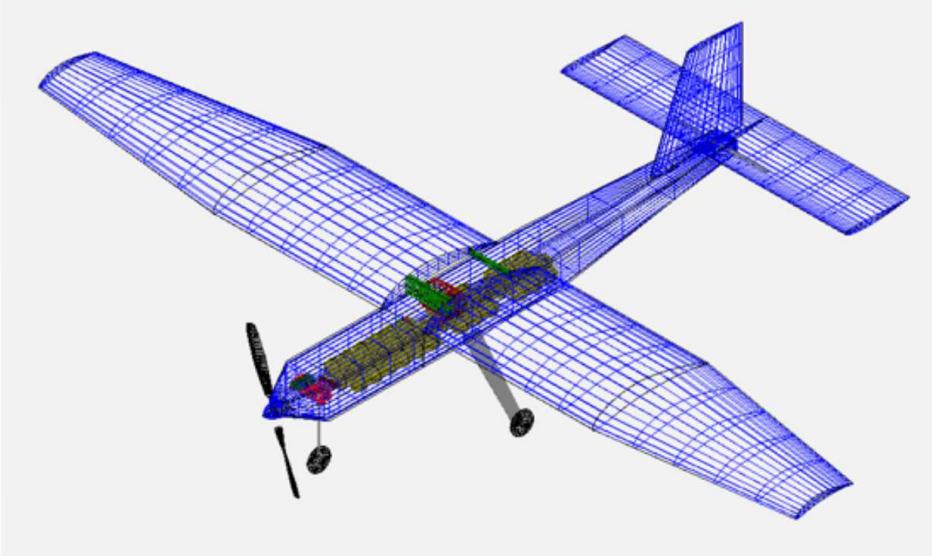


Image from Penn State [4]

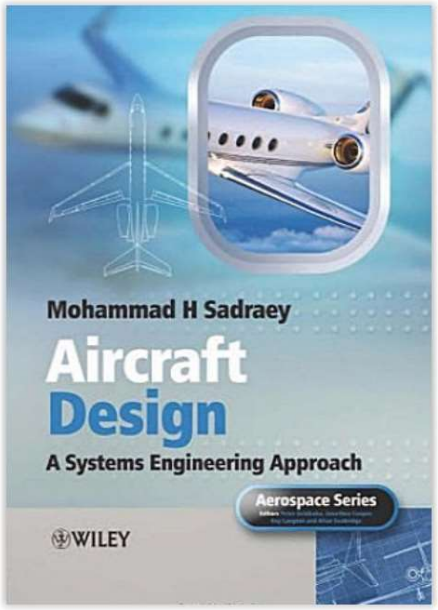
LITERATURE REVIEW

- Title - Design and Fabrication of a Remote-controlled Plane for the Advanced Class SAE Aero Design Competition
- North Carolina Agricultural and Technical State University
- Includes all major system discussions made for this aircraft to the right
- Peer-Reviewed Paper
- 2019 this team placed 6th

This is an image form the 2019 6th place Aero Regular competition [5]

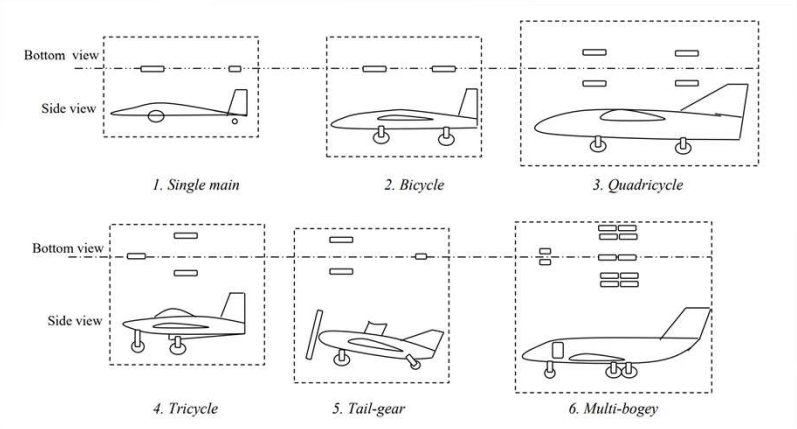
LITERATURE REVIEW CONTINUED

- Title - Aircraft Design
- Discusses wing configuration, Max takeoff wight calculations
- Tail designs, propulsion types and so much more
- Textbook
- Also include MatLab code for certain calculation

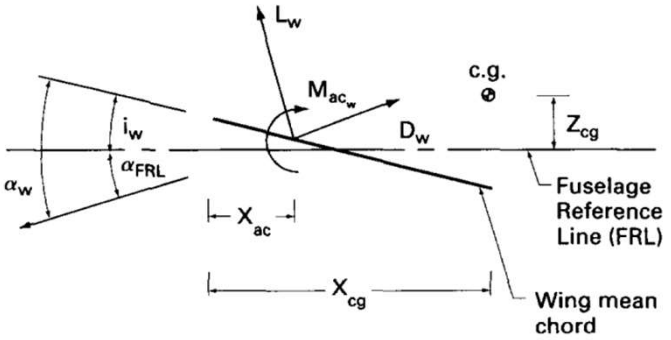


Cover of the textbook [6]

BASIC AIRCRAFT DESIGN



Textbook Figure for Landing Gear Design [8]



Textbook Figure for Wing Pitching Moment [7]

- Basic concepts regarding wing, tail, and landing gear design
- Comparison of different assembly types
- How to achieve trim
- Helpful formulas

AERODYNAMICS

- Review of fundamental theories of Aerodynamics
- Incompressible flow application over airfoil at low-speed, low-altitude conditions
- Thrust and factors affecting thrust force
- Engine performance parameters

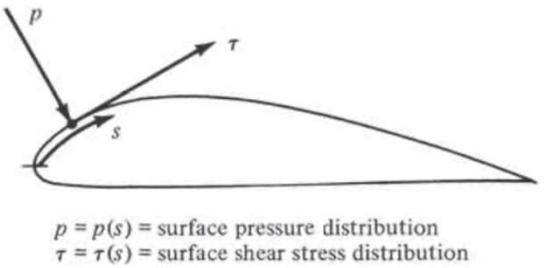


Figure 1.15 Illustration of pressure and shear stress on an aerodynamic surface.

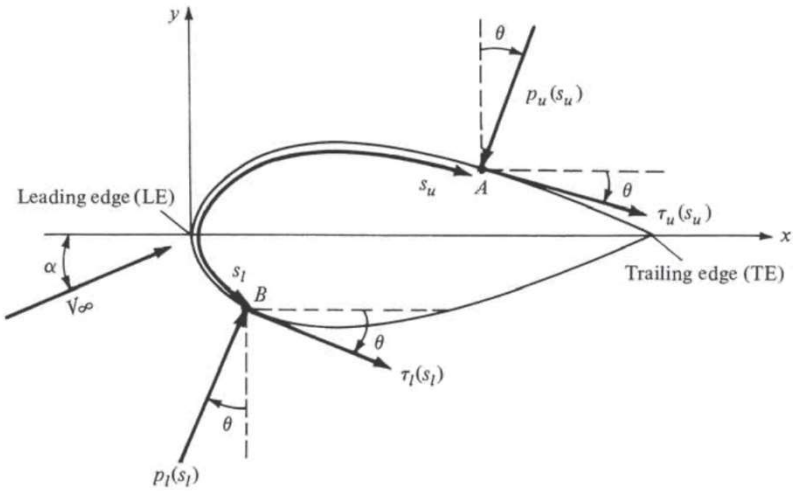


Figure 1.18 Nomenclature for the integration of pressure and shear stress distributions over a two-dimensional body surface.

AERODYNAMICS

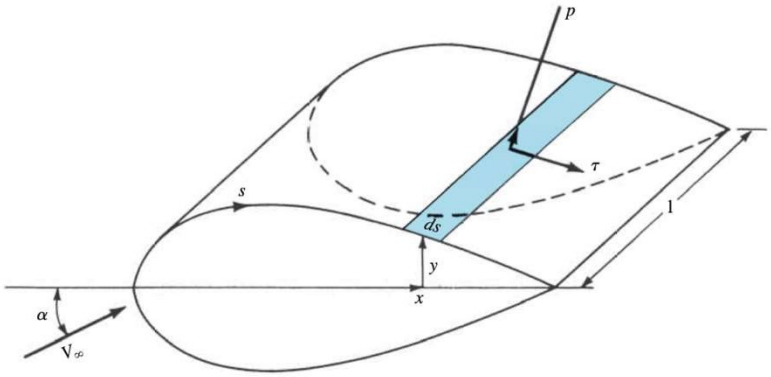
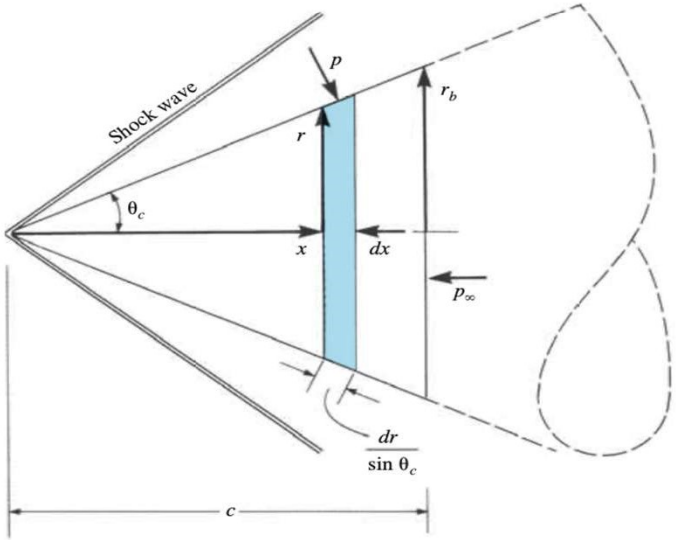


Figure 1.19 Aerodynamic force on an element of the body surface.



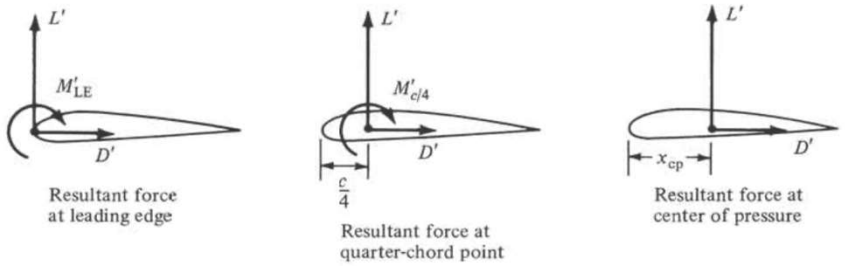
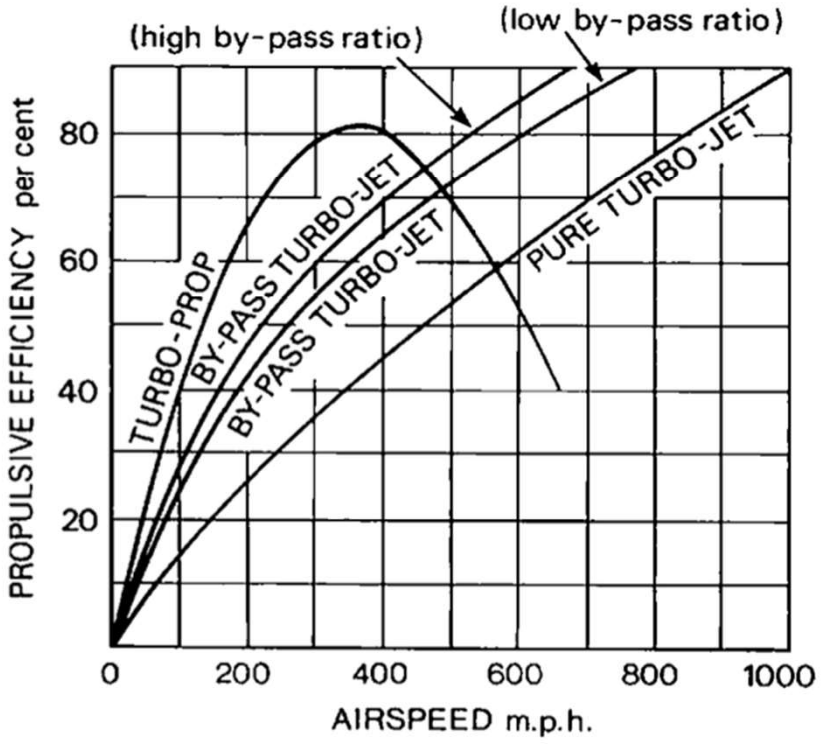
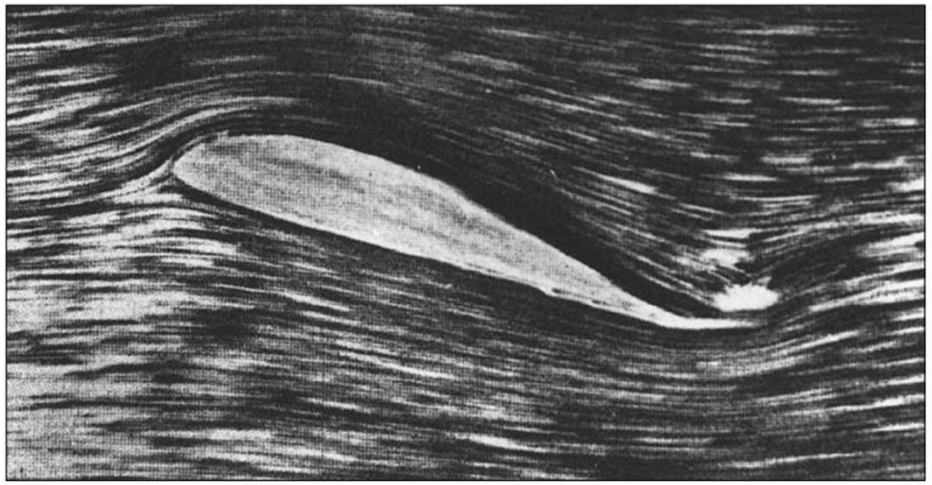


Figure 1.26 Equivalent ways of specifying the force-and-moment system on an airfoil.



AERODYNAMICS



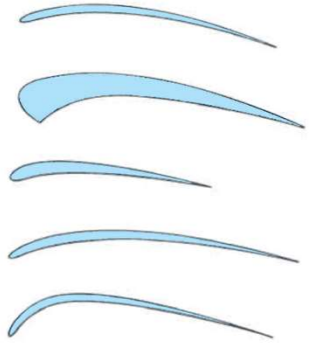
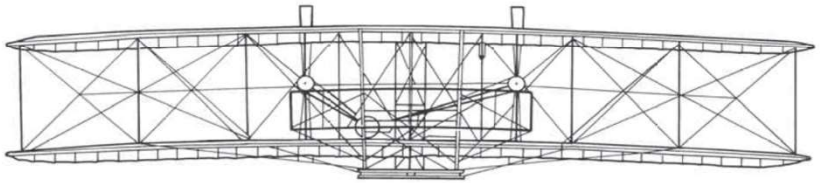


Figure 4.61 Some typical airfoil shapes tested by the Wright brothers in their wind tunnel during 1902–1903.



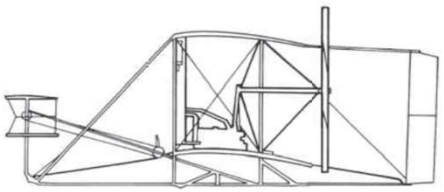
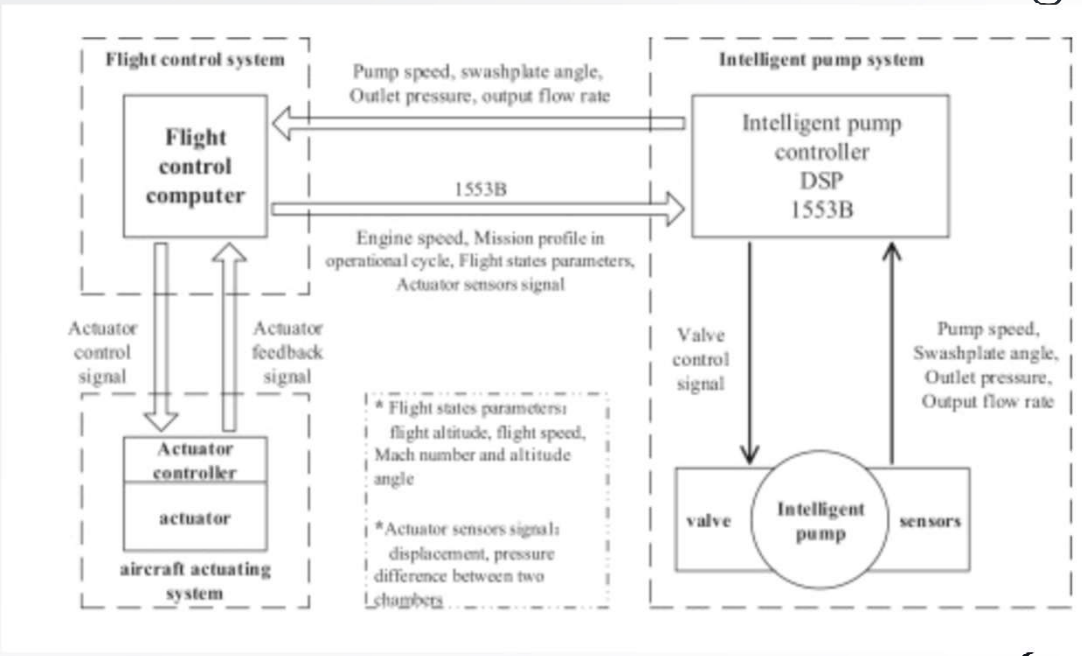


Figure 4.62 Front and side views of the 1903 Wright Flyer. Note the thin airfoil sections. (*Courtesy of the National Air and Space Museum*).

FLIGHT CONTROL SYSTEMS

- Example of information exchange between a flight control computer and controller of the intelligent pump.



CUSTOMER REQUIREMENTS

Image for customer needs [14]

- Analyze previous competitors
  - See what makes a team successful
    - Is it cost
    - Is it design
    - Is it time spent on the project
- Optimize for new payload
- Possibly prototype

ENGINEERING REQUIREMENTS

Cartoon illustrating a plane falling apart [15]

- Cargo bay carrying standard size 5 soccer ball
- Weight (lbs.) – Max 55 lbs
- Drag (lbs.)
- Lift (lbs.)
- Velocity (mph)
- 1:1 Prop to motor gear ratios
- Power (watts) - 1000W power limiter
- Amperage (mAh) -3000 mAh battery minimum
- Voltage (Volts) -6 Cell (22.5 Volt)
- Wingspan (in) - 132 in. (12 ft.) wingspan maximum

House of Quality (HoQ)

Customer Requirements	Customer Weights	Weight (lbs.)	Power (W)	Amperage (mAh)	Voltage (V)	Distance (Ft.)	Wingspan(In.)	Cargo Size (In.^3)	Drag (lbs.)	Factor of Safety (n)	Velocity (MPH)	Lift (lbs.)
1. Reliability	7	1				9			9	3	3	
2. Durability	8	3						3	3	9		
4. Power Limiter	6	1	9	9	9						3	
6. Cost	7		3		3		9	9		3		
7. 1:1 Motor Gear Ratio	6		3			3	3				3	9
8. Safety	9		1	3						9		
9. Manufacturability	5		3				9	9	3	9		
10. Cargo Capacity	2	9						9	3			3
11. Flight Maneuvarability	7	3				9	9		9		9	9
12. Ground Maneuverability	10	3				9						
13. Lightweight	7	9	3				9	9	3		3	9
14. Stability	10	1				3	1				9	9
Absolute Technical Importance (ATI)		179	138	81	75	264	262	213	192	240	231	276
Relative Technical Importance (RTI)		8	9	10	11	2	3	6	7	4	5	1
Target ER values		30	1000	3000	22.5	500	96	670	5	1.2	20	33
Tolerances of Ers		2	0	0	0	50	2	6	2	0.1	5	2
Testing Procedure (TP#)												

Approval (print name, sign, and date):

Team member 1: _____Aiden Hudson__31 January 2021___

Team member 2: _____Dylan Morgan__31 January 2021___

Team member 3: _____Ryan Stratton__31 January 2021___

Team member 4: _____Hettiarachchi "Gajaba" Wickramarathne__31 January 2021___

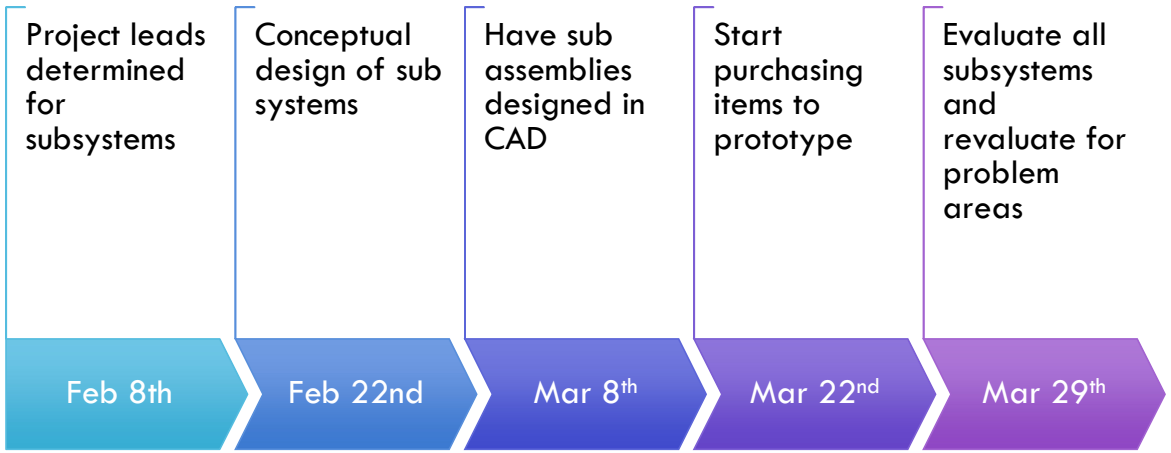
Client Approval:

Snapshot of our QFD

QFD

- QFD lays out most and least important customer needs and engineering requirements to reach most satisfying results
- Most important ER's
  - Lift
  - Distance
  - Wingspan
  - Factor of Safety
  - Drag
- Customer requirements are to take into consideration all aspects and determine which are most important to succeeding at competition

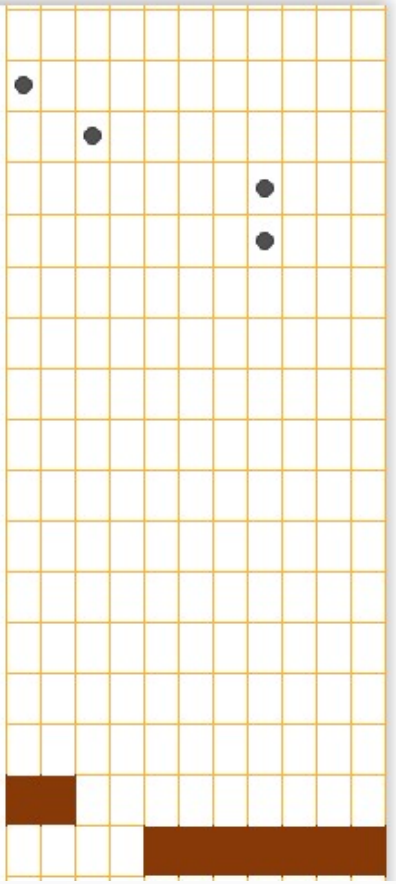
SCHEDULE



-Note: on time at this juncture, but have a lot of work in the future here

Image of Gantt chart that is being created for visual reference

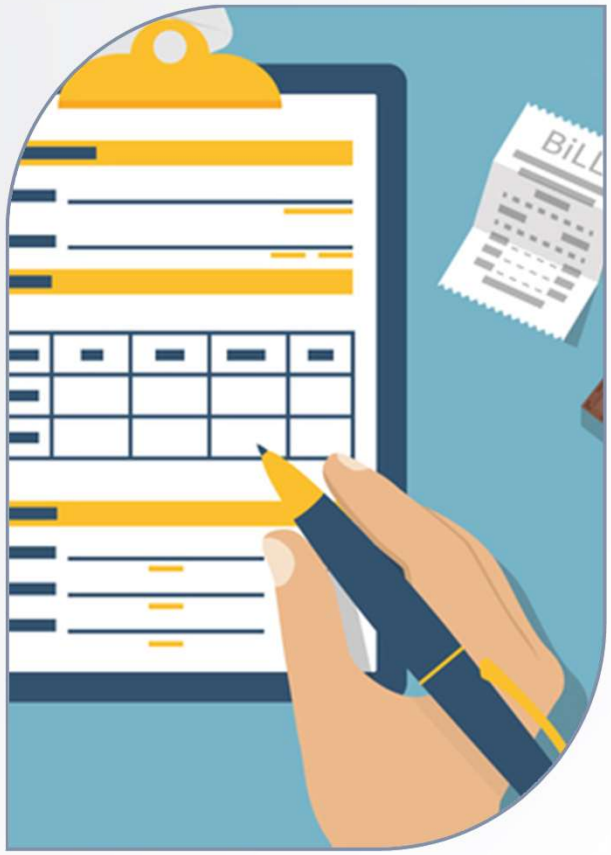
Peer Evaluation 1	Individual		2/5/2021	1	2/5/2021
Self-Learning	Individual		2/19/2021	1	2/19/2021
Presentation 2	Team		2/21/2021	1	2/21/2021
Peer Evaluation 2	Individual		2/26/2021	1	2/26/2021
Preliminary Report	Team		2/26/2021	1	2/26/2021
Individual Analytical Analysis	Individual		4/16/2021	1	4/16/2021
Peer Evaluation 4	Individual		4/27/2021	1	4/27/2021
Website Check 2	Ryan		4/27/2021	1	4/27/2021
Time Cards Due					
Week 1 Time Card	Team		1/18/2021	1	1/18/2021
Week 2 Time Card	Team		1/25/2021	1	1/25/2021
Week 14 Time Card	Team		4/19/2021	1	4/19/2021
Week 15 Time Card	Team		4/26/2021	1	4/26/2021
Team Time Line					
Project leads determined for subsystems	Team		2/1/2021	7	2/1/2021
Conceptual design of sub systems	Individual (subsystem leads)		2/8/2021	14	2/8/2021
Have sub assemblies designed in CAD	Individual		2/22/2021	14	2/22/2021



Snapshot of our Gantt Chart

BUDGET

- If we choose,
  - Current estimate is put at $1500
  - This would be for prototyping
  - Creation of product excreta
- Note this is different from original requirements



Keeping track of bills [16]

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