SAE Aero Regular: Presentation 1

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Project Description

Since 1986 SAE has put on an annual design competition for undergraduate students that provides them with real life engineering challenges.

There are three classes of competition regular, micro, and advanced. This team will be working on the regular design, and the competition is split up into a report, presentation, and flight trials at the event. A high percentage of score is allocated to the written design report and oral presentation to put emphasis on communication skills.

Figure 1: SAE logo

Figure 2: Past NAU team

The western competition is held at an airfield in Encino, CA and will take place from April 3rd-5th this year.

Main requirements for regular class this year include:

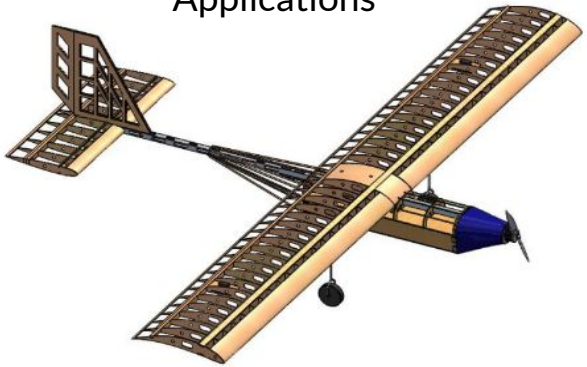
- Take off/land on 100 foot runway
- Able to carry oversized cargo (soccer balls and steel weights)
- 10 foot max wingspan
- 1000 Watt power limiter

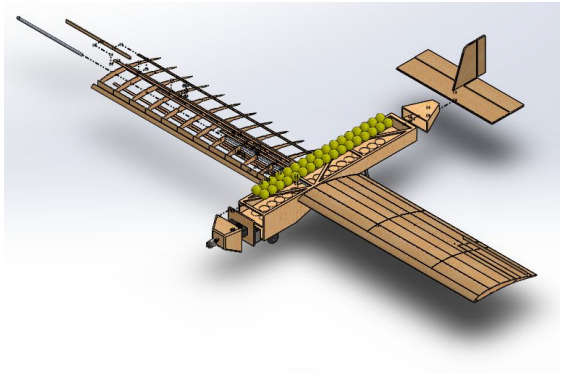
Chris Galus

Background / Benchmarking (Full System)

State of the Art

Designs for Similar Applications





[3][4][5][6]

Jacob Cong

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Benchmarking (Sub-System)

Wing Shape

Empennage

[7][8][9]

Landing Gear

Literature Review

Team has been doing research since before this semester began and utilized many different online resources. Areas of focus include:

- Propeller Design - Alex
- Airfoil shape - Alex/Nate
- Wing shape - Jacob/Chris
- Empennage style - Nate/Jacob
- Flap/elevator/rudder construction - Nate/Jacob
- Overall flight stability - Chris/Jacob
- Radio control - Alex/Chris

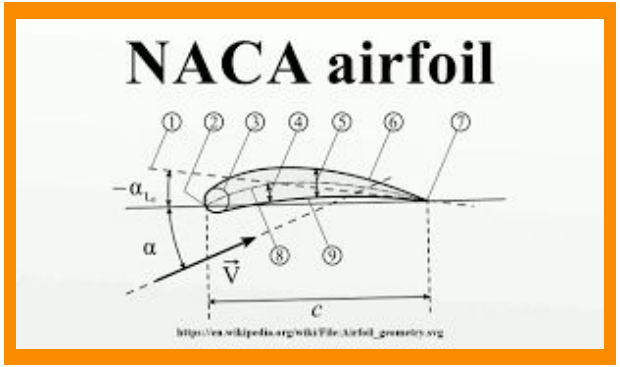

Figure 10: NACA airfoil

Discussions with individuals that have previously competed, and review of the submitted reports from previous NAU teams online research

The team will be studying from Fundamentals of Aerodynamics by John Anderson, and will also utilize the Mechanical Design Process text provided by Dr. Oman

Customer Needs	Customer Weights
Ball Capacity	10
Steel Weight Capacity	9
Low Wing Span	9
Low Cargo Bay Length	9
Lack of Crash	10
Cargo Accessability	6
Robust Design	10
Reliable Design	9
Inside Budget	10
Safe to Operate	10
Takeoff & Landing Capability	10
Control Authority	7
Constructability	5

Customer Needs & Engineering Requirements

- SAE Aero
  - The Competition
- Customer Needs Categories:
  - Scoring (Client: SAE)
  - General (Client: NAU Capstone)
  - Miscellaneous (Client: Team)

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System HoQ

Project: SAE Aero Regular Class
Date: 9/17/2019

Customer Needs	Customer Weights	Technical Requirements: Size	Weight	Power	Cost	Lift	Low Drag	Ease of Assembly/Repair	Velocity	Turning	Load/Unload Time	Cabin Length	Wing Span	Success Rate
Ball Capacity	10	9	3	9	3	3	9		3		9	9	1	1
Steel Weight Capacity	9	3	9	9	1	9	9		3		3	1	1	1
Low Wing Span	9	9	3		3	9	9	1	3	3			9	3
Low Cargo Bay Length	9	9	3				9	3	9	1	3	9		
Lack of Crash	10		9	9	3	9	9		3	9			1	9
Cargo Accessability	6	3	3	1	1	1	1	9			9			1
Robust Design	10	1	1	1	3			1					3	3
Reliable Design	9	1	1	1	3	3	3	1		3	1			3
Inside Budget	10	1		1	9									
Safe to Operate	10													9
Takeoff & Landing Capability	10	9	9	9	3	9	9		9	1				3
Control Authority	7	3	3	9	3	3			9	9				9
Constructability	5	9	1		9	1	1	9		3	3	3	3	
Technical Requirement Units		in^3	lbs	Kw	$	lb	lb	min	mph	rad/s	s	in	in	%
Technical Requirement Targets		13824	35	1	1000	55	10	15	25	0.8	120	10	96	90
Absolute Technical Importance		2 482	5 408	3 449	8 345	4 431	1 551	13 154	7 348	9 241	10 222	11 195	12 155	6 382
Relative Technical Importance		2	5	3	8	4	1	13	7	9	10	11	12	6

- Engineering Requirements
  - Measurable metrics of CN's

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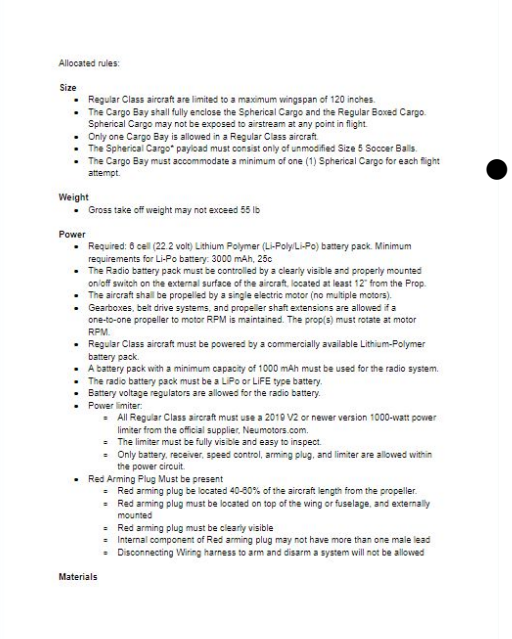
Customer Needs & Engineering Requirements



Allocated rules:

Size
- Regular Class aircraft are limited to a maximum wingspan of 120 inches.
- The Cargo Bay shall fully enclose the Spherical Cargo and the Regular Boxed Cargo. Spherical Cargo may not be exposed to airstream at any point in flight.
- Only one Cargo Bay is allowed in a Regular Class aircraft.
- The Spherical Cargo* payload must consist only of unmodified Size 5 Soccer Balls.
- The Cargo Bay must accommodate a minimum of one (1) Spherical Cargo for each flight attempt.

Weight
- Gross take off weight may not exceed 55 lb

Power
- Required: 6 cell (22.2 volt) Lithium Polymer (Li-Poly/Li-Po) battery pack. Minimum requirements for Li-Po battery: 3000 mAh, 25c
- The Radio battery pack must be controlled by a clearly visible and properly mounted on/off switch on the external surface of the aircraft, located at least 12" from the Prop.
- The aircraft shall be propelled by a single electric motor (no multiple motors).
- Gearboxes, belt drive systems, and propeller shaft extensions are allowed if a one-to-one propeller to motor RPM is maintained. The prop(s) must rotate at motor RPM.
- Regular Class aircraft must be powered by a commercially available Lithium-Polymer battery pack.
- A battery pack with a minimum capacity of 1000 mAh must be used for the radio system.
- The radio battery pack must be a LiPo or LiFE type battery.
- Battery voltage regulators are allowed for the radio battery.
- Power limiter:
  - All Regular Class aircraft must use a 2019 V2 or newer version 1000-watt power limiter from the official supplier, Neumotors.com.
  - The limiter must be fully visible and easy to inspect.
  - Only battery, receiver, speed control, arming plug, and limiter are allowed within the power circuit.
- Red Arming Plug Must be present
  - Red arming plug be located 40-60% of the aircraft length from the propeller.
  - Red arming plug must be located on top of the wing or fuselage, and externally mounted
  - Red arming plug must be clearly visible
  - Internal component of Red arming plug may not have more than one male lead
  - Disconnecting Wiring harness to arm and disarm a system will not be allowed

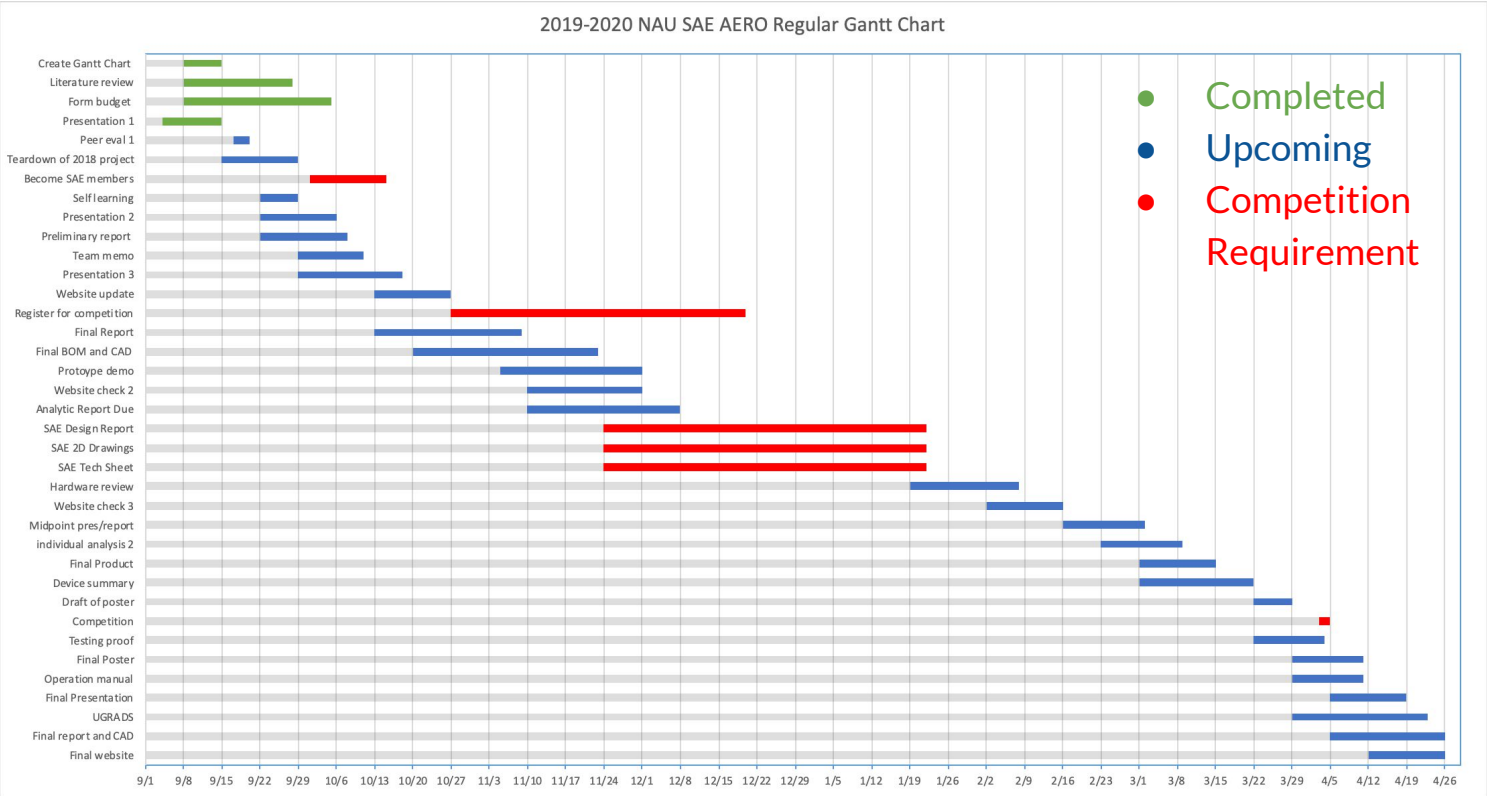
Materials

- Remaining Rules

  We've also compiled a categorized list of SAE rules

Alex Klausenstock

Schedule



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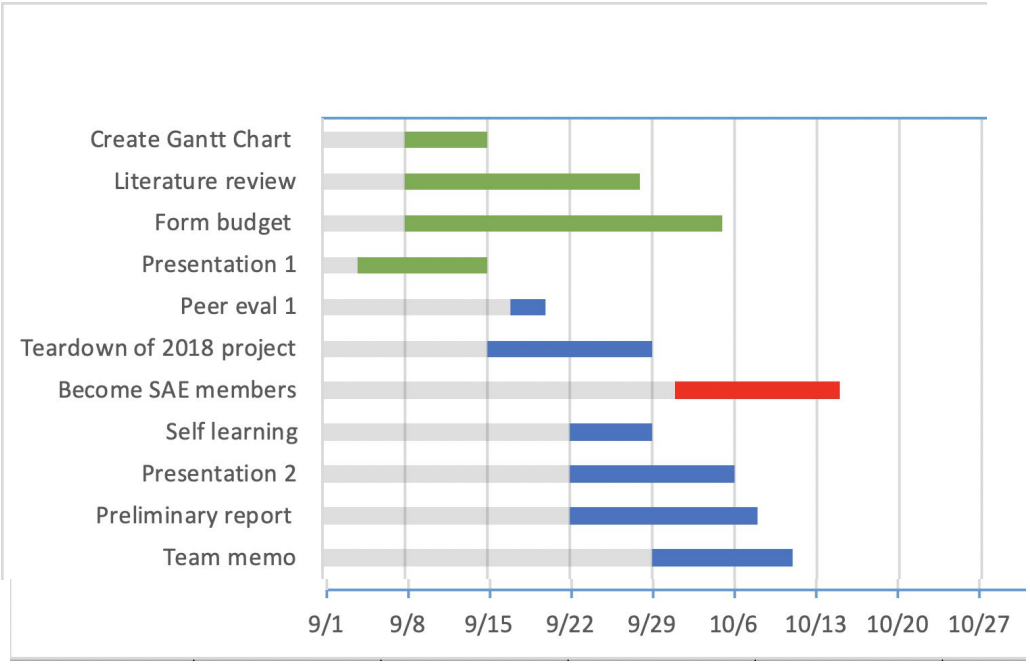
Nathan Valenzuela

Schedule



- Completed
- Upcoming
- Competition Requirement

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Budget

	NAU SAE Preliminary Budget	
	Funding	Note
	$3,000.00	Gore Donation
	Costs	Note
Gore Donation Applicable	$1,100.00	SAE Competition Entry Fee
	$1,000.00	2017-18 Plane Estimate ($1100)
	$100.00	Required Stickers and Gore Branding
Summed	$2,200.00	Gore Funding Usage. For use of plane parts, requirements, and construction only
Gore Donation Non-Applicable	$500.00	2 Nights - Hotel
	$250.00	Gas (1200 miles,17mpg, 3.50$ per gallon)
	$25.00	SAE Membership (4 needed)
	$75.00	Academy of Model Aeronautics License
	$150.00	Team Shirts and Vehicle Markings
Additional Funds Required	$1,075.00	Not deductable from Gore donation, this is our target fund raising goal for memberships and travel expenses
	Leftover	Note
	$800.00	Gore Funding Usage. For use of plane parts, requirements, and construction only
	Fundraising Goal	Note
	$1,200.00	Total fund raising goal. Trip expenses

- Current Funding
  - Allowed Uses
- Costs
  - Gore Applicable
- Required Funds
  - Trip Expenses & Memberships
- Fundraising Goal
  - Options

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Q/A

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Work Cited

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