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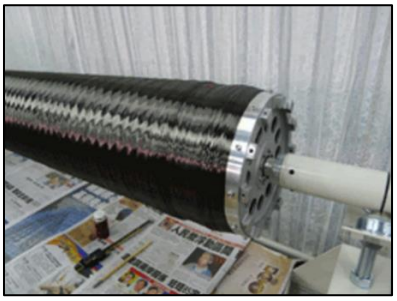
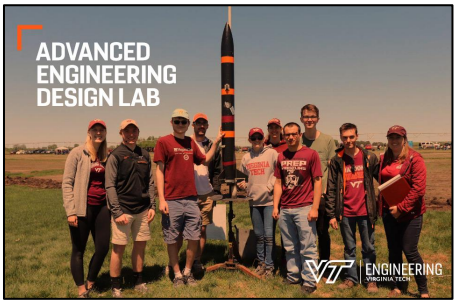
Advanced Engineering Design Lab - *AEDL*

Annual Report
2020





Executive Summary

This annual report summarizes activities at Virginia Tech's *Advanced Engineering Design Lab* for spring of 2020. The AEDL is supported by the College of Engineering and the Department of Aerospace and Ocean Engineering. The report includes sections on lab expenditures, student demographics, improvements to the facility and the AEDL COVID 19 response.

This year 35 Virginia Tech students completed the general use survey. Due to the COVID 19 pandemic, students were not permitted in the facility on its planned opening day of April 1st. All team competitions were canceled as well.

Total lab equipment and material expenditures totaled $7610. Monetary team sponsorship included a $5000 award from the Student Engineer's Council (SEC) and extensive financial support for rent, equipment, materials, and remodeling costs was provided by the *Kevin T. Crofton Department of Aerospace and Ocean Engineering.*

The following report has additional information on safety certifications, a new lab promotional video, website and brochure, and faculty involvement. Additional details on lab operations are available from the Ware Lab/AEDL manager, Dewey Spangler (spanger@vt.edu).

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Introduction

The Advanced Engineering Design Lab (aka *AEDL*) is an undergraduate design facility housed within Virginia Tech's College of Engineering and Aerospace and Ocean Engineering departments at 501 Industrial Drive Road, in Blacksburg, Virginia. The facility is home to ten undergraduate teams from various departments within the college. AEDL management consists of:

- Dr. Eric Paterson – AOE Department Head
- Dewey Spangler, PE - Manager
- Bob Schoner - Assistant Manager
- Cory Thompson – AOE/AEDL Purchasing Agent

The AEDL facility spans over 7,000 square feet of space divided into the areas shown in Figure 1. Each area requires safety certification as specified in the *AEDL Policy Manual*. These areas include:

1. General Areas (Rooms 101 through 110, 115, 118)
2. Machine Shop – (Room 117)
3. CAD Lab – (Room 119)
4. Administrative Areas – (Rooms 111, 112 and 113)

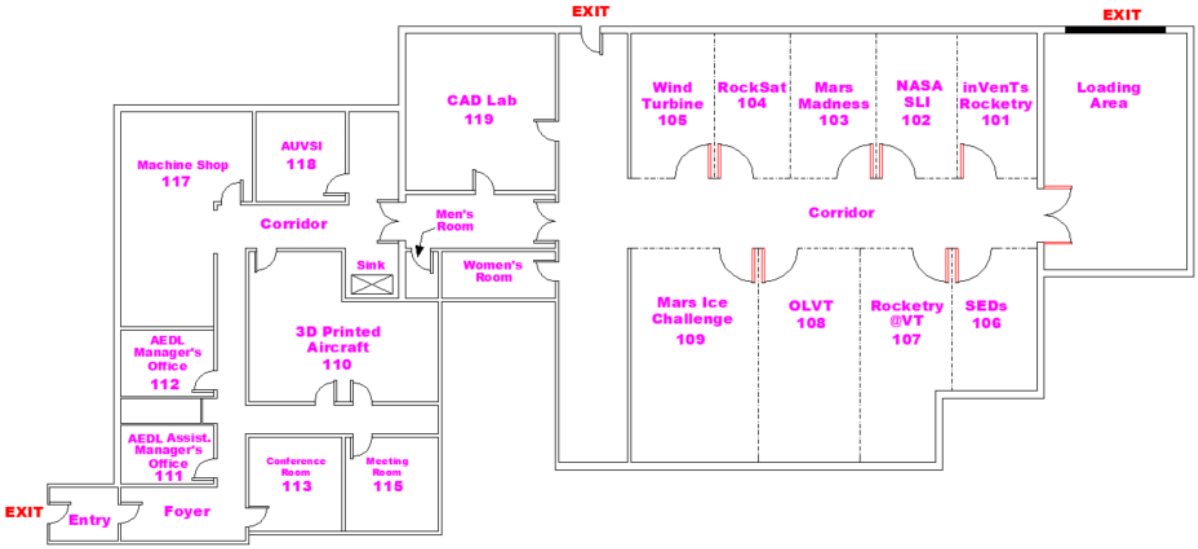

Figure 1 – AEDL Facility.

Student and Faculty Membership

35 students from various academic departments completed the AEDL general survey prior to the facility closing on March 16 due to the COVID 19 pandemic. Table 1 is a list of AEDL team leads and faculty advisors. Table 2 is a comprehensive list of student team members for 2020.

Table 1 – AEDL Team Leads and Faculty Advisors for 2020

AEDL Team	Team Lead(s)	Faculty Advisor(s)
inVents Rocketry	Nolan Englund	Kevin Shinpaugh
Mars Ice Challenge	Eli Marrero	Kevin Shinpaugh
Mars Madness	Dev Patel	Kevin Shinpaugh
NASA Student Launch Initiative Team (SLI)	Ashley Thomas, Joseph Cunningham	Pat Artis
Orbital Launch Vehicle Team (OLVT)	Sanzio Angeli	Kevin Shinpaugh, Pat Artis
Rocketry@VT	Jonathan Jaffee	Kevin Shinpaugh
RockSAT- X@VT	Kris Stone, Nick Jones	Kevin Shinpaugh
SEDs Rocketry	Shreya Chandramouli	Jonathan Black
Wind Turbine Team	Alvaro Armaza, Jack Hawes	Matt Kuester, Author Ball
3D Printer Aircraft Team	Milad Rowshanbakhtfardian, Dylan Adie	Craig Woolsey

Table 2 – AEDL Student Team Membership for 2020

First	Last	Major	Level	Credit?	AEDL Team
Dylan	Adie	AOE	Junior	Volunteer	3D Printed Aircraft Team
Milad	Rowshanbakhtfardian	AOE	Junior	Volunteer	3D Printed Aircraft Team
Justin	Hartman	MINE	Sophomore	Volunteer	Mars Ice Challenge
Shail	Patel	ISE	Sophomore	Senior Design	Mars Ice Challenge
Prem	Patel	MSE	Sophomore	Volunteer	Mars Ice Challenge
Yash	Patil	ME	Sophomore	Volunteer	Mars Ice Challenge
Sarang	Rajeev	ECE	Sophomore	Volunteer	Mars Ice Challenge
Tanushree	Shinde	AOE	Sophomore	Volunteer	Mars Ice Challenge
Parker	Treubert	AOE	Senior	Senior Design	Mars Ice Challenge
Timothy	Whited	AOE	Senior	Senior Design	Mars Ice Challenge
James	Buchanan	ME	Senior	Volunteer	Mars Madness
Jubel	Kurian	AOE	Freshman	Volunteer	Mars Madness
Joseph	Cunningham	AOE	Senior	Research	NASA SLI
Ashley	Thomas	AOE	Sophomore	Volunteer	NASA SLI
Sanzio	Angeli	AOE	Senior	Senior Design	OLVT
Evan	Clark	ECE	Junior	Volunteer	OLVT
Kevin	Engel	Physics	Junior	Volunteer	OLVT
Ben	Jackson	AOE	Sophomore	Volunteer	OLVT
Casey	Latoski	ECE	Junior	Volunteer	OLVT
Chase	Leuchtmann	AOE	Junior	Volunteer	OLVT
Aimee	Loviza	AOE	Sophomore	Volunteer	OLVT
Daniel	Lynch	AOE	Junior	Volunteer	OLVT
Mitchell	Mann	AOE	Senior	Senior Design	OLVT

Reece	Preisser	Physics	Junior	Volunteer	OLVT
Adrian	Ruvalcaba	ECE	Junior	Volunteer	OLVT
Josiah	Selby	AOE	Senior	Senior Design	OLVT
Matt	Werner	AOE	Grad Student	Volunteer	OLVT
Noah	Wilde	ME	Sophomore	Volunteer	OLVT
Nicholas	Jones	AOE	Junior	Volunteer	RockSat
Brennan	Rausch	ME	Junior	Volunteer	RockSat
Eric	Williams	ME	Sophomore	Volunteer	RockSat
Alvaro	Armaza	CEE	Junior	Volunteer	Wind Turbine Team
Elizabeth	Horley	ECE	Junior	Volunteer	Wind Turbine Team
Katalin	Luetkehoelter	ME	Senior	Volunteer	Wind Turbine Team
Minh	Nguyen	ECE	Sophomore	Volunteer	Wind Turbine Team

AEDL COVID 19 Response

On March 16 AEDL was closed to all students and faculty due to COVID 19. On August 3 teams will be allowed to return to the lab under limitations as mandated by the governor of Virginia. In order to accommodate students returning to campus a lab planning tool is now in effect. The planning tool indicates the maximum number and placement of students in various project bays and common areas to conform with personal distancing rules (see Table 3). This document also indicates that masks must be warn at all times while in the AEDL. Copies of the planning tool are available from Ware Lab/AEDL management at spangler@vt.edu. All figures from the planning tool indicating correct personal distancing are shown in Appendix A.

Table 3 – COVID 19 Bay/Common Area Student Capacities

AEDL/Common Area	Room Number	Capacity	Figure (Appx. A)
CAD Lab	119	5	A1
AEDL Machine Shop	117	4	A2
Foyer	NA	3	A3
3DPAC Team	110	6	A4
Wind Turbine	105	2	A5
RockSAT	104	2	A5
Mars Madness	103	2	A5
NASA SLI	102	2	A5
inVenTs Rocketry	101	2	A5
Mars Ice Challenge	109	4	A6
OLVT	108	4	A6
Rocketry@VT	107	4	A6
SEDs	106	2	A6
Conference Room	113	3	A7
Team Bay	115	2	A7
AUVSI Team	118	2	A8
	Total:	**49**	

Figure 2 shows placement of clear partitions (green lines) and student team member locations for 3’ x 6’ and 4’ x 8’ work tables. Red circles are 6’-6” in diameter to maintain 6’-0” nose-to-nose distances.

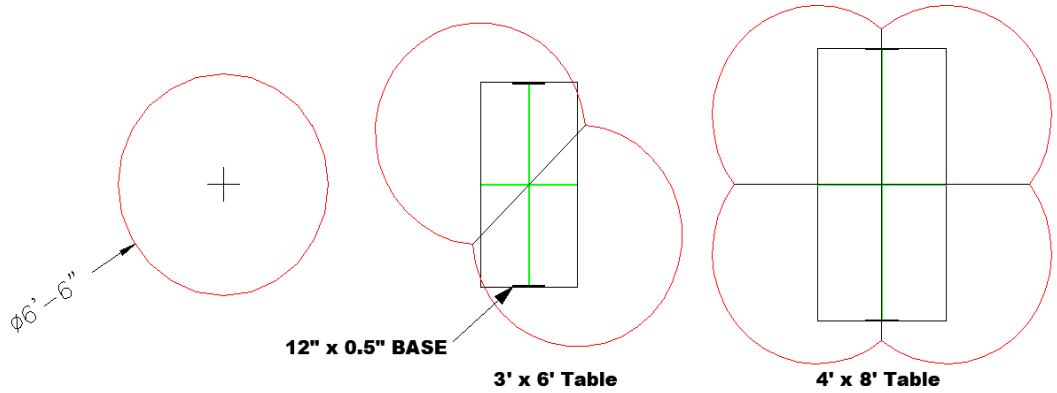

Figure 2 – Partition and personal-distancing layout for 3’x 6’ and 4’ x 8’ team work tables.

In addition, all teams must submit a signed copy of the AEDL Standard Operating Plan (SOP – Appendix B) to the lab manager. The first page of the SOP must be displayed on the team’s cage wall, visible from the hallway. This SOP has details on:

- Surface disinfection,
- Social distancing,
- Use of masks and gloves,
- Daily best practices, and
- Prohibitions against occupancy

In partnership with Virginia Tech’s Industrial Engineering Department and Ware Lab, AEDL plans to build clear plexiglass partitions to be placed at various locations in the lab. Cost associated with each 4’ x 8’ partitions is between $70 and $100 and represents a significant savings compared to buying pre-assembled partitions from local and online vendors.

Figure 3 – 4’ x 4’ clear plexiglass partition manufactured in the ISE 2214 lab.

AEDL Promotional Video

Each year the Joseph F. Ware Advanced Engineering Lab hosts summer camps for tours of its facility. These groups include CTech^2, CEED, NASA Inspire and 4H. Camp participants learn a lot and many decide to attend Virginia Tech to join a Ware Lab team. In the same spirit, AEDL planned to host summer camps this year but was unable due to the COVID 19 pandemic. To provide an option for visitors a video of the AEDL was produced by the COE that feature lab faculty advisors Pat Artis and Kevin Shinpaugh, and lab assistant manager Bob Schoner. The video is posted on the AEDL website and as of July has received 176 views on YouTube. A new edition of the video is planned for Fall 2020 to include student interviews and will be featured at the 2020 Roanoke STEAM (*Science, Technology, Engineering, Arts, Math*) virtual event.

Figure 4 – AEDL Promotional Video.

New AEDL Website

AEDL's website is located at…

https://eng.vt.edu/advanced-engineering-design-lab.html

The site has links to student projects, facilities, administration, sponsorship, and information on obtaining safety certification and entry to the lab. The URL for this site will be distributed to students, potential donors and visitors to AEDL who want to learn more about the facility.

Figure 5 – Spaceport America Cup 2018.

New AEDL Brochure

In partnership with the College of Engineering and the AOE department, AEDL has published an electronic version of its first lab brochure which lists AEDL teams, support staff, and faculty advisors. Distribution of the brochure with be to visiting families, potential sponsors, and the public at large. An online version can be found at the AEDL website at…

https://eng.vt.edu/content/dam/eng_vt_edu/advanced-engineering-design-lab/aedl-_qbrochure.pdf

Paper versions of the brochure will be printed for distribution in the late fall or early spring semester.

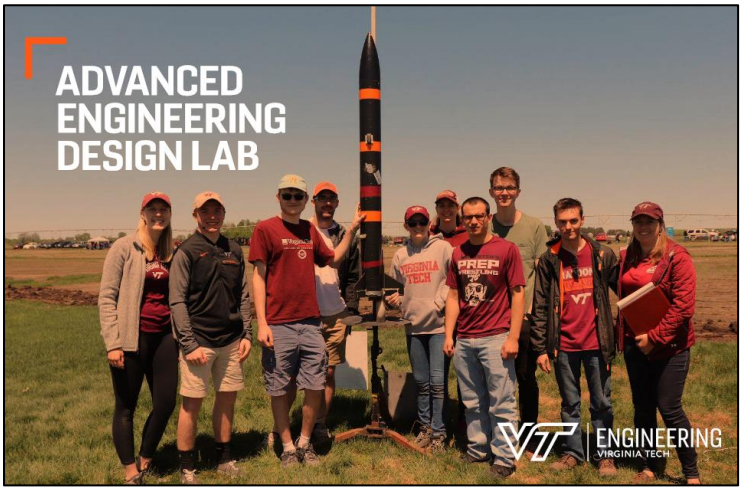

Figure 6 – AEDL brochure for 2020-21 academic year.

New AEDL Equipment

This year, thanks to support from the AOE department, AEDL was able to purchased equipment for its new machining lab. These include items shown in Figures 7, 8 and 9.

Figure 7 – Tool wall display rack (left) and RIKON disk and belt sander.

Figure 8 – CNC 4-axis filament carbon fiber winder to manufacture rocket tube assemblies.

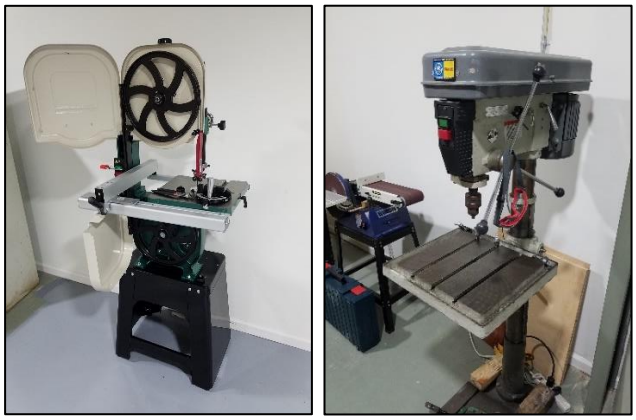

Figure 9 – Grizzly - 14" 1 HP bandsaw (left) and drill press (Ware Lab donation).

Lab Improvements

AEDL consists of space rented by Virginia Tech's Aerospace and Ocean Engineering department that was previously occupied by a local printing company. Extensive remodeling of the space includes: painting and electrical work, installation of project bay walls, upgraded lighting, and installation of Hokie Card swipe access, mainly financed by the AOE department. Figures 10 through 17 illustrate upgrades made prior to opening the facility.

Figure 10 – New rear door from project bays to loading dock.

Figure 11 – Floor painting in office area hallways.

Figure 12 – Installation of project bay walls.

Figure 13 – Project bay spaces with SDS (Safety Data Sheet) holders.

Figure 14 – Rear door from offices to project bay area before (left) and after.

Figure 15 – Machine shop before (left) and after (Room 117).

Figure 16 – Machine shop before (left) and after (Room 117).

Figure 17 – Administrative offices (Rooms 111 and 112).

Team Competitions

Due to the closing of AEDL on March 16 most teams did not participate in competition events. Students participate in regional and national events throughout the United States and it is anticipated, with the reopening of the lab on August 3rd, that teams will be able to pursue competition goals for 2020-21. The VT Wind Turbine team did participate in an online version of their competition and earned 4th place in project development. More on this event can be found at:

https://www.energy.gov/eere/articles/california-state-university-maritime-academy-and-james-madison-university-claim-top

AEDL Policy Manual and Safety Certification

In order to gain access to AEDL students must pass six online EHS courses, sign a waiver form, and sign a policy manual confirmation form. This form signifies that a student team member has read and understands of provisions of the AEDL Policy Manual, posted on the AEDL Canvas site. The policy manual includes sections on:

Section 1 - *Access to AEDL,*

Section 2 - *AEDL Safety Certification*,
Section 3 - *Proper use of AEDL Facility*,
Section 4 - *Proper Code of Conduct*, and
Section 5 - *Parking Regulations*.

In addition, Section 6 is required reading for all students working in the lab and details events that occurred at two university student labs due to improper use of safety PPE and lab equipment. Section 7 includes the *Policy Manual Confirmation Form* that must be signed and email to the AEDL manager.

Students completing all requirements for admission are issued a badge similar to those shown in Figure 18. Badges are displayed on project cage walls, visible from the hallway and change color each year.

Figure 18 – AEDL badges for 2019-20 academic year.

Lab Expenditures

AEDL expenditures are shown in Table 4 for spring semester of 2020. Major purchases include a 4-axis filament carbon fiber winder (see Figure 8), a Grizzly - 14" 1 HP bandsaw (Figure 9), and a Rikon 50-122 6"x48" combo belt and disk sander (Figure 7). These items were purchased by the AOE department to equip our new machine shop and for supplies to paint various areas of the lab. In addition, the College of Engineering installed a swipe card access system for the lab's side exterior door costing $1990.

Table 4 – AEDL Expenditures for 2020

Date	Vendor	Item	Total
12-May	Amazon	4 axis filament winder	$3,995.00
21-May	Home Depot	Anti Skid additive	$ 53.82
21-May	Home Depot	epoxy roller	$ 10.00
22-May	Amazon	Cobalt drill bits Irwin	$ 92.00
22-May	Amazon	Rexbetiallen set	$ 32.99
22-May	Amazon	Tacklife screwdriver set	$ 39.97

22-May	Amazon	Rikon 50-122 6"x48" belt/disc sander	$ 416.59
22-May	Amazon	32" x 16" x2	$ 46.99
22-May	Amazon	60 pcs 1/4"	$ 40.97
22-May	Amazon	peg board locks	$ 19.38
22-May	Amazon	plier rack	$ 17.50
22-May	Amazon	screwdriver rack	$ 19.98
27-May	Grizzly	Grizzly G0555LA35 - 14" 1 HP Deluxe Bandsaw	$ 754.00
27-May	Amazon	96" long bars for x-winder	$ 189.14
1-Jun	Soller Composites	T700 CF tow	$ 39.24
1-Jun	Amazon	HMS4 CF Tow	$ 203.24
1-Jun	Amazon	820Resin Gal + 824 slow	$ 138.23
4-Jun	Amazon	mixing cups (100) 10 oz	$ 29.96
4-Jun	Amazon	mixing cups (36) 2oz	$ 23.98
4-Jun	Amazon	mixing sticks 500	$ 9.99
4-Jun	Amazon	30" craft paper roll (200')	$ 23.89
4-Jun	Amazon	paper roll cutter 30"	$ 31.49
4-Jun	Macklin Missile Works	Fin Jig 4"	$ 176.00
5-Jun	Amazon	box/open combo mm&"	$ 79.97
5-Jun	Amazon	socket set mm&"	$ 59.98
5-Jun	Amazon	socket wrench	$ 45.22
5-Jun	Amazon	socket organizer SAE	$ 21.62
5-Jun	Amazon	socket organizer metric	$ 19.98
5-Jun	Amazon	tape measure	$ 11.32
5-Jun	Amazon	Plier set 7 pcs	$ 33.98
5-Jun	Amazon	utility knife - 2 pack	$ 12.98
8-Jul	New Egg	Yellow Toner	$ 245.89
8-Jul	New Egg	Black Toner	$ 164.89
13-Jul	Home Depot	20V DeWalt Drill	$ 198.00
13-Jul	Amazon	Fein Vacuum accessories	$ 115.87
14-Jul	Amazon	Fein Vacuum bags	$ 47.59
14-Jul	Global	First Aid Kit (50)	$ 143.85
15-Jul	Amazon	Ice Pack	$ 4.98
		Total:	**$7610.47**

AEDL Demographics

Ethnicity, gender, academic major, academic level, transfer information, and volunteer information is gathered each year when students complete the general admissions survey. Summaries of collected data are shown in Tables 5 through 10. AEDL had two transfer students this year from New River Community College. Both served on the Orbital Launch Vehicle Team. Table 11 is a list of square footage allocated to each team and common area in the AEDL.

Table 5 – Ethnicity

Ethnicity	Number	Percent
Asian	8	22
Hispanic	2	6
Middle Eastern	1	3
Other	3	8
White	22	61
Total	**36**	**100**

Table 6 – Gender

Gender	Number	Percent
Female	6	17
Male	30	83
Total	**36**	**100**

Table 7 – Academic Major

Major	Number	Percent
AOE	18	50
CEE	1	3
ECE	6	17
ISE	1	3
ME	6	17
MINE	1	3
MSE	1	3
Physics	2	6
Total	**36**	**100**

Table 8 – Academic Level

Level	Number	Percent
Freshman	1	3
Grad Student	1	3
Junior	13	36
Senior	9	25
Sophomore	12	33
Total	**36**	**100**

Table 9 – "How did discover AEDL?"

Event	Number	Percent
Gobblerfest	1	3
Team Info Session	26	72
Ware Lab Tour	1	3
Word-of-Mouth	8	22
Total	**36**	**100**

Table 10 – Credit vs. Volunteer

Role	AEDL Team	Number	Percent Total Lab Population
Research Credit	NASA Student Launch Initiative Team	1	3
Senior Design	Mars Ice Challenge	3	8
Senior Design	Orbital Launch Vehicle Team (OLVT)	4	11
Volunteer	3D Printed Aircraft Team	2	6
Volunteer	Mars Ice Challenge	5	14
Volunteer	Mars Madness	2	6
Volunteer	NASA Student Launch Initiative Team	1	3
Volunteer	Orbital Launch Vehicle Team (OLVT)	11	31
Volunteer	RockSat	3	8
Volunteer	Wind Turbine Team	4	11
	Total Credit:	**8**	**22**
	Total Volunteer:	**28**	**78**
	Total:	**36**	**100**

Table 11 – Lab Square Footage

Bay/Area (Room #)	Sq. Ft.	Student Number*	Sq. Ft. per Student
inVenTs Rocketry (101)	245	0	-
NASA SLI (102)	245	2	123
Mars Madness (103)	245	2	123
RockSat (104)	245	3	82
Wind Turbine (105)	245	4	61
SEDs (106)	245	0	-
Rocketry@VT (107)	530	0	-
Orbital Launch Vehicle Team (108)	530	14	38
Mars Ice Challenge (109)	530	8	66
3D Printed Aircraft Team (110)	470	2	235
Assistant Manager's Office (111)	110	N/A	N/A
Manager's Office (112)	120	N/A	N/A
Conference Room (113)	150	N/A	N/A

Meeting Room (115)**	170	N/A	N/A
Machine Shop** (117)	459	N/A	N/A
AUVSI (118)	156	0	-
CAD lab** (119)	467	N/A	N/A
Rest Rooms	130	N/A	N/A
Hallways/Foyer	590	N/A	N/A
Corridor	1130	N/A	N/A
Loading Area**	661	N/A	N/A
Total	**7670**	**36**	**Average: 213**

*Based on students completing AEDL survey prior to lab closing.
**Denotes common-use area.

Conclusion

This summary report for the Advanced Engineering Design Lab includes student demographics, outreach, expenses, and the AEDL COVID 19 response. Undergraduates from multiple majors comprise the teams who design, manufacture and compete top tier projects. The new AEDL facility is destined to become a major focal point of undergraduate engineering teams for Virginia Tech's College of Engineering and Department of Aerospace and Ocean Engineering.

Appendix A – AEDL Lab Planning Tool Room Capacities

Figures A1 through A8 correspond to Figures 1 through 8 in the AEDL Lab Planning Tool. For a complete copy of this document contact AEDL management at spangler@vt.edu.

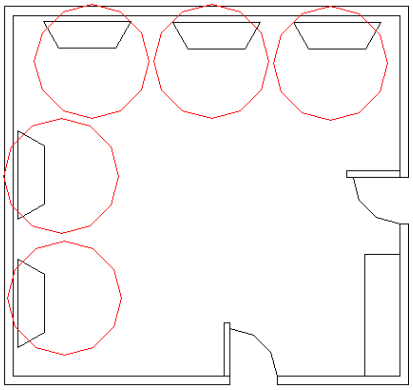

Figure A1 – CAD Lab (5 max).

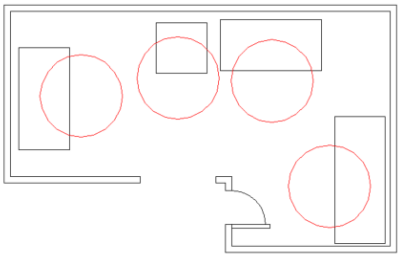

Figure A2 – AEDL Machine Shop (4 max).

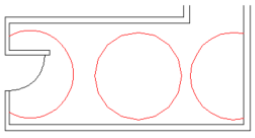

Figure A3 – FOYER (3 max)

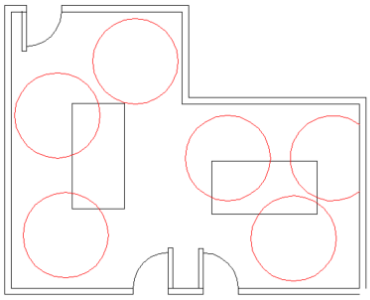

Figure A4 – 3DPAC Team (6 max)

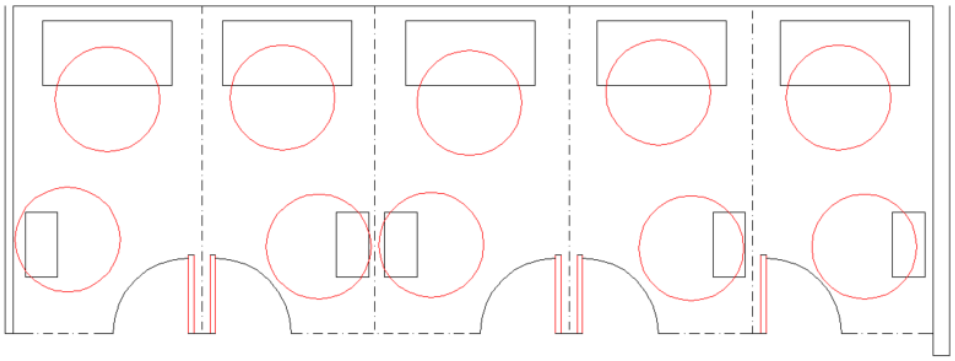

Figure A5 – Team Bays from left: Wind Turbine, RockSAT, Mars Madness, NASA SLI, inVenTs Rocketry (2 max per bay)

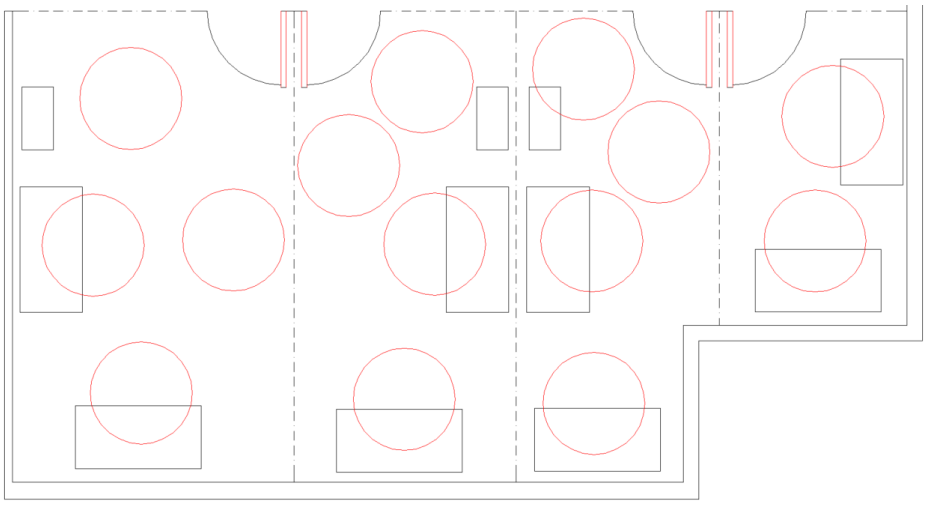

Figure A6 – Team Bays from left: Mars Ice Challenge, OLVT, Rocketry@VT (4 max), SEDs (2 max)

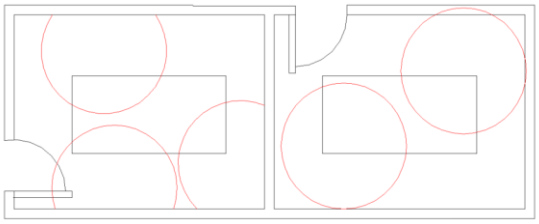

Figure A7 – Left: Conference Room (3 max) and Team Bay (2 max**)**

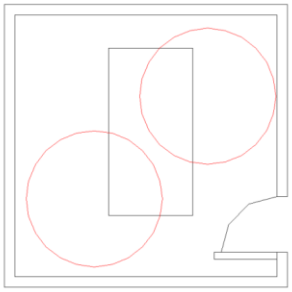

Figure A8 – AUVSI Team (2 max)

Appendix B – COVID 19 AEDL SOP

SOP First Page: *To be displayed on project bay wall (for a copy of the complete SOP contact AEDL management at spangler@vt.edu):*

COVID-19 Standard Operating Procedures for On-Site Laboratories – AEDL
This first page must be displayed on the project bay cage visible from the hallway.
Updated: 04.09.2020

AEDL Team Name:	
AEDL Team Faculty Advisor(s):	
Date admission to lab approved by team faculty advisor:	
Internal Lab Safety Coordinators/Lab Managers:	Dewey Spangler, Bob Schoner
Lab Phone: 540-553-5863	
Location:	501 Industrial Park Drive, Blacksburg VA, 24060
Project Bay Room Number:	

SOP Last Page: *To be completed by each team and submitted to AEDL management:*

Training Documentation of (signature of all users is required)
Principal Investigator Standard Operating Procedures Approval
Team Faculty Advisor:
Printname
Signature
Co-Team Faculty Advisor (If applicable): Printname
Signature

_____
Approval Date
Team Lead (or safety officer): I have read and understand

Print Student Name	Signature	Date

Other Team Personnel working in AEDL: I have read and understand

Print Student Name	Signature	Date