



UNC CHARLOTTE

The WILLIAM STATES LEE COLLEGE of ENGINEERING

Senior Design Project Description

Company Name	<i>Highland Composites</i>	Date Submitted	<i>11/11/2018</i>
Project Title	<i>Universal Silicone Mold and Extractor for Carbon Fiber Tube Production (HC MOLD)</i>	Planned Starting Semester	<i>Spring 2019</i>

Personnel

Typical teams will have 4-6 students, with engineering disciplines assigned based on the anticipated Scope of the Project.

Please provide your estimate of staffing in the below table. The Senior Design Committee will adjust as appropriate based on scope and discipline skills:

Discipline	Number	Discipline	Number
Mechanical	4		
Computer			
Other ()			

Company and Project Overview:

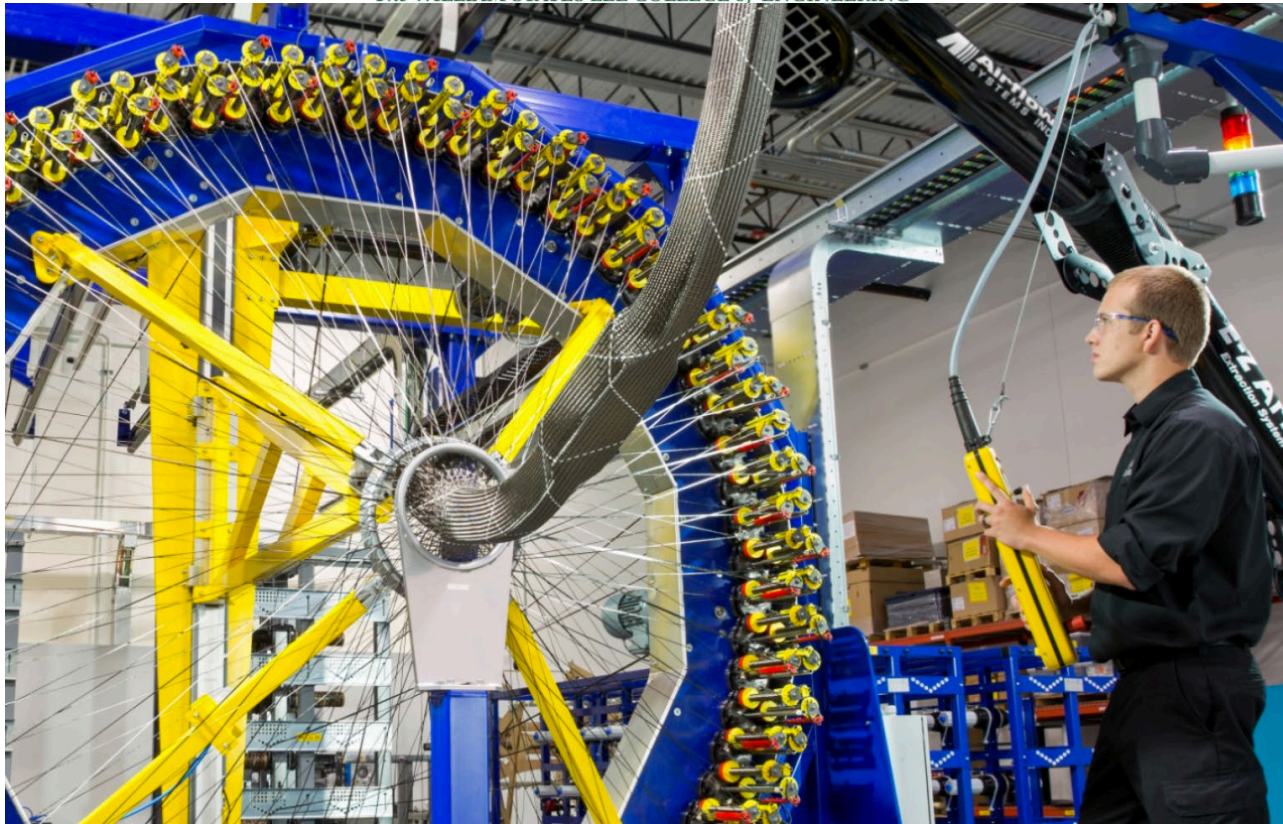
Highland Composites is an advanced composites manufacturing company that specializes in the production of carbon and glass fiber composite structures. Utilizing various manufacturing processes, such as braiding, filament winding, resin infusion/transfer molding, and traditional hand layup, Highland is able to take the raw fiber and transform it into a finished composite structure ready for use within industry.

Highland Composites' facility is AS-9100D and ISO-9001 certified, allowing for the pursuit and involvement in contracts that span a wide range of industries including aerospace, automotive, industrial, energy, and sporting goods.



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Highland Composites braider producing a part that will then be infused with resin



Overbraided form

Project Requirements:

Highland Composites' research and development group is responsible for designing and testing composite structures based on fibrous reinforcements and resin transfer molding. One way of producing composite structures is by braiding high-strength synthetic fibers over shaped mandrels.



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Once these mandrels have been braided with the appropriate amount of reinforcement, they must be infused with resin and cured to produce the advanced composite component for further testing and property validation. The critical process parameters are temperature, pressure, and quantity of resin in the reinforcement. After resin infusion and curing, the fiber reinforced component can be difficult to separate from the mandrel and thus an extracting tool is needed. An instrumented mold tool capable of measuring and controlling process parameters such as temperature and resin flow is desired to establish best practice for subsequent production.

Highland Composites would like to streamline this process through the design of a mold/tooling system that will allow a reinforcement to be placed into a mold, saturated with resin and cured, and then safely separate the composite and mandrel without risk of damaging the composite material. An instrumented mold tool that can accommodate various shaped components using variable inserts is desired. For simplicity, a tube mold is sufficient for this project. The mold tool should accommodate tubular shapes up to 4 feet long and allow for diameters of 0.5 to 3 inches.

Expected Deliverables/Results:

- Multi-piece mold tool (external shell) able to accommodate varying geometries through inserts should include:
- The use of as many off-the-shelf components as possible
- Inlet and outlet ports for resin and supplied vacuum
- Vacuum/pressure seals of mold cavity (Low pressure to 100 psi)
- Heated from RT to 150 degrees Fahrenheit via integrated heaters (cartridge or heat blanket with closed loop control)
- Integrated thermocouples
- Integrated load cells capable of measuring ingress of resin in mold cavity (gram scale)
- Pressure sensor(s) for cavity pressure (0-1 mbar/Torr scale)
- Peristaltic pump (stepper motor) to supply resin in conjunction with vacuum (flow rate control via by load cells and resin ingress)
- Closed loop control of mold heating and integration of thermocouple sensors through a controller
- Data collection of time, temperature, pressure, and flow rate
- Mechanical system that will extract the mandrel in the post-cure process

Disposition of Deliverables at the End of the Project:

The work product will be displayed at the last Expo then immediately handed over to Highland Composites.

List here any specific skills, requirements, specific courses, knowledge needed or suggested (If none please state none):

- Pre-select Student: Taylor Pearce (intern at Highland)
- CAD (parametric driven model)
- Process controls (temperature, pressure, load cells)
- Data collection
- Selection of seals, heating elements, sensors



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- Motor control