

## UNC Charlotte – Lee College of Engineering Senior Design Program

### Senior Design Project Description

<b>Company Name</b>	<i>Charlotte Pipe</i>	<b>Date Submitted</b>	<i>10/29/19</i>
<b>Project Title</b>	<i>Design of a System to Reliably Remove Parting Lines on Sand Molds Used for Pipe Casting (CP_PART)</i>	<b>Planned Starting Semester</b>	<i>Spring 2020</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:

<b>Discipline</b>	<b>Number</b>	<b>Discipline</b>	<b>Number</b>
Mechanical	3	Electrical	1
Computer	1	Systems	
Other ( )			

#### Company and Project Overview:

For over a century Charlotte Pipe and Foundry Company has been manufacturing pipe and fittings exclusively in the USA, employing 1,400 loyal, hard-working Americans. Today they manufacture the industry's broadest range of standard and specialty DWV products, including cast iron and plastic pipe and fittings.

Charlotte Pipe is headquartered in Charlotte, NC, and has seven plant locations across the United States.



Cast Iron Foundry – Charlotte, NC

Charlotte Pipe produce a full line of service and extra-heavy cast iron soil pipe and fittings from 2” to 15,” and double-hub pipe from 2” to 6”. We also manufacture a full line of hubless pipe and fittings, from 1 ½” to 15”. In addition to these standard products, the casting facility does custom castings for a wide variety of customer products. This project will focus on the design of an improved way to remove parting lines on sand molds.



### **Project Requirements:**

In order to make hollow pipes and fittings, sand cast molds are used. Specially formulated sand is compressed into mold shapes that are required to form the desired part. The sand molds are used within the casting molds. Molten iron is poured into the casting mold and the sand mold keeps the molten metal out of the desired locations. Once the metal is cooled, the casting mold is vibrated to break up the sand mold. The broken up sand cast pieces are removed and recycled. The cast iron parts move along to finishing operations.

Charlotte pipe has molding operations for hundreds of different pipes and fittings. When a particular part number is going to be cast, the sand and molten metal molds are retrieved from storage and set-up in the machines. The mold envelope is standard (3ft x 3ft x 1ft), but within this standard size, there are hundreds of part shapes. Once the shell core machines are set-up, sand cores for a particular part will take place for typical run, which would last 2 or more days.

Sand molds are two part molds. When the mold is opened, there is a parting line on the sand mold. This parting line can project outward from the part up to a few millimeters. These parting lines, if not removed, would project into the wall of the pipe or fitting. This would result in a reduced thickness of the wall which compromises the integrity of the pipe or fitting. When this occurs, the defective parts are detected in later test and quality assurance operations. Those defective parts are rejected and sent to be re-melted and recycled. To prevent these defects, prior to the casting using the sand mold, there is a manual operation to remove the parting line with a file. The parting lines are easily filed off, but the operator must be careful to not file into the surface of the part. See photos below:



UNC CHARLOTTE

The WILLIAM STATES LEE COLLEGE of ENGINEERING

### Examples of Sand Molds

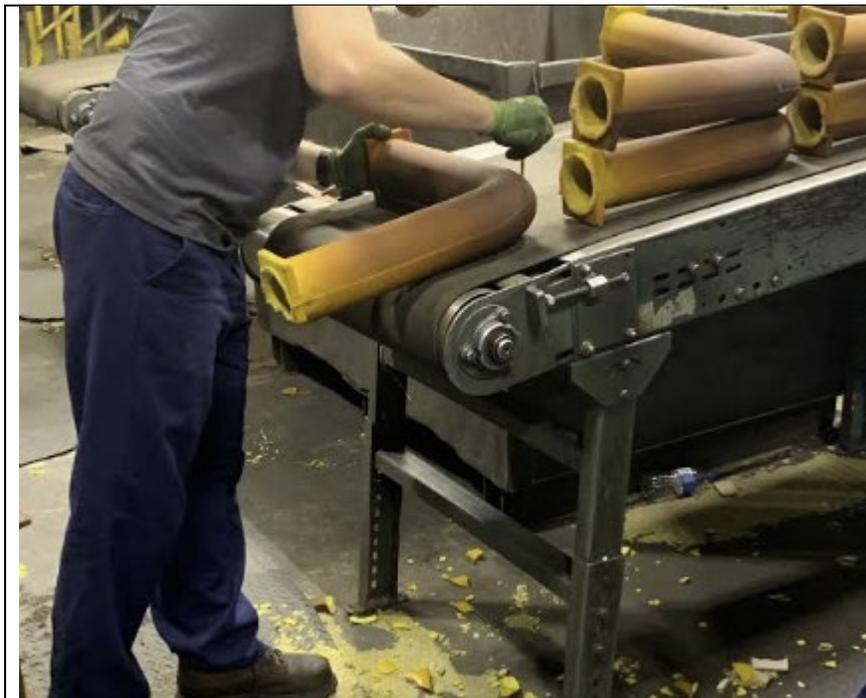


### Examples of Parting Lines



UNC CHARLOTTE

The WILLIAM STATES LEE COLLEGE of ENGINEERING



Parting lines being filed off.

Parts are lifted out of a large bin and placed onto the conveyer where the parting line is filed off.

Filed parts are stacked onto the conveyer, then sent onward into the casting process.

The objective of the project is to come up with an improved way of removing the parting line on sand molds before they enter the metal casting process. It is envisioned that the operator will



UNC CHARLOTTE

*The WILLIAM STATES LEE COLLEGE of ENGINEERING*

remain a part of this operation. The project team will develop a replacement method to remove the parting line, but the operator will continue to take the part from the parts delivered in the bin, but instead of filing the part, will use the students designed system to remove the parting line, then place it onto the conveyor.

The goals for the new method will be to remove the parting line with a higher reliability than the human operator with a goal of 100% parting line removal with high certainty. The time required for the operation with the new method should be the same or less than the current method.

The student's design solution can use their creativity to develop fixtures, tooling, machines etc. which will accomplish the objective. Because production runs will typically last for days and hundreds of parts, it is allowable to have different fixtures for each part and the set-up of the student's method will be part of the set-up when there is a change over to a new part. These part changeovers take 3 minutes in machine with core on belt acting as a buffer. Typical shift could see between 4 and 30 changeovers. Charlotte Pipe will provide a subset of 5 part types that will be the focus for this project, but it is desired that the student design be able to be extended to all of the parts, which use sand casting.

#### **Expected Deliverables/Results:**

- Prototype solution that will be designed to work with five part examples
- Cycle time for operation to be no longer than the current system.
- Method to improve the reliability of 100% of the parting line compared to an Operator and a file
- Method to not gouge (go into the part, below the parting line) the sand mold

#### **Disposition of Deliverables at the End of the Project:**

Provide the system to the supporter at the conclusion of the Expo

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

- Design reviews to be held at Charlotte Pipe's Charlotte location.
- Project will require travel to Charlotte Pipe's Charlotte location.