Layup Table for Process Improvement in Door Manufacturing

Original Objectives

- Evaluate current layup table design and door assembly process
- Modify or redesign current table layout to reduce material and operator variations
- Build functional prototype for future integration into current production line
- Test functionality of prototype with regards to compliance to given requirements
- Successfully implement prototype at the manufacturing facility

Requirements

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Description</th>
<th>Utilization</th>
<th>Name</th>
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</thead>
<tbody>
<tr>
<td>1. Smoothness</td>
<td>Constant force throughout</td>
<td>Valuable</td>
<td>Valuable</td>
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<td>2. Drop-in rollers</td>
<td>Reduces material fabrication cost by 50%</td>
<td>Valuable</td>
<td>Valuable</td>
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<td>3. Structure</td>
<td>Improved visualization of the layup table</td>
<td>Valuable</td>
<td>Valuable</td>
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<td>4. Braking</td>
<td>Preventing oversize across the layup table</td>
<td>Valuable</td>
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<td>5. Quick adjustment</td>
<td>Manual adjustment for ideal positioning</td>
<td>Valuable</td>
<td>Valuable</td>
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<tr>
<td>6. Interchangeable</td>
<td>Two hand no tie down to ensure safety of operators</td>
<td>Valuable</td>
<td>Valuable</td>
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<tr>
<td>7. Production process</td>
<td>Detailed instruction manual for layup table</td>
<td>Valuable</td>
<td>Valuable</td>
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<tr>
<td>8. Inventory</td>
<td>Detailed inventory of the layup table</td>
<td>Valuable</td>
<td>Valuable</td>
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Concepts

Problem Statement

The Sponsor is a high-volume prefab door manufacturer. The company’s facility produces custom and standard sized doors. Due to variations in material components and inconsistencies with operator assembly, additional material has been added to the edge components of the door. This excess material is machined in an automated process to square the door. This addition and machining of edge material adds waste to the process. Furthermore, if the door fails squareness specifications at the end of the process, it will be scrapped. The desired scrap rate is not to exceed 2%. The Sponsor has requested modifications or redesign of the build table to reduce variability in the layup process by squaring the door through mechanical means (fixturing, guides, pneumatics, suction, other) without increasing cycle time. Producing a higher rate of products that meet or exceed specifications and reducing waste material will have a positive financial impact.

Final Design

STRUCTURAL DESIGN
- 80/20 frame
- Drop-in rollers to accommodate a variety of door lengths
- Translating actuator "carriage" to accommodate a variety of door widths
- Rollers to provide ease of transition.

CLAMPING "CARRIAGE" BAR DESIGN
- Pneumatic compressive force to reduce bowing
- Mechanical brake lever on all four slides
- Actuators synchronized to ensure no racking
- Two hand no tie down to ensure safety of operators

Modified Objectives*

- **Functional Prototype**
  - Solution: Existing assemblies, custom fabricated parts, pneumatic components, and remaining raw material to be packaged and delivered to whichever party is tasked with project completion moving forward.
- **Operational Training**
  - Solution: Team will develop a document containing details on table operation. This will be included as a deliverable in the documents and relevant files.
- **Test Plan & Report**
  - Solution: The team will provide a testing plan with details about testing procedure. Images and other documents needed for testing procedure clarification will be provided as a deliverable.
- **Senior Capstone Symposium**
  - Solution: A digital symposium poster presentation will take place of previously scheduled public demonstration.

Summary

What we will provide to sponsor:
- CREO part/assemblies for layup table
- 80/20 components for layup table assembly
- Pneumatic circuit diagram
- Pneumatic components
- Relevant project files including BOM

Due to Covid-19 we will also provide:
- More in-depth testing plan
- Instruction document for layup table assembly
- Instructions for Pneumatic system assembly
- Inventory Documentation

Team & Acknowledgements

- **Students:**
  - George Hickein
  - B.S.E – Engineering Technology
  - Levi Auman
  - B.S.E – Engineering Technology
  - Adam Griffin
  - B.S.E – Mechanical
  - Olivia Witham
  - B.S.E – Mechanical

- **Mentor:**
  - Brett Banther
  - Rapid Center Engineer

- **Acknowledgements:**
  - Ed Jarnac
  - Carolina Fluid Components

**Sponsor**

*On March 16, 2020 classes and labs were closed to students due to the COVID-19 Pandemic. Without access to fabrication and testing equipment, Objectives and Deliverables were modified accordingly.*