

Devils Backbone Gantry Design and Analysis

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The brewing process at Devils Backbone Brewing Company involves the use of a centrifugal separator to remove all solids from the final beer. To avoid clogging and contamination, the separator is disassembled and thoroughly cleaned. The current disassembly process involves using a forklift to remove a 2500 pound hood off the separator and transport it nine feet to a nearby cleaning station. The design team from VMI was tasked with designing a gantry system that would be a permanent replacement to the forklift.

Although the general concept of lifting and moving the hood was relatively straight forward there were a number of other design constraints that added complexity to this process. The primary constraints that prevented the use of a premanufactured system were a 12ft ceiling and the need to lift the hood nearly 9ft off the ground. Figure 1 below illustrates this design problem.

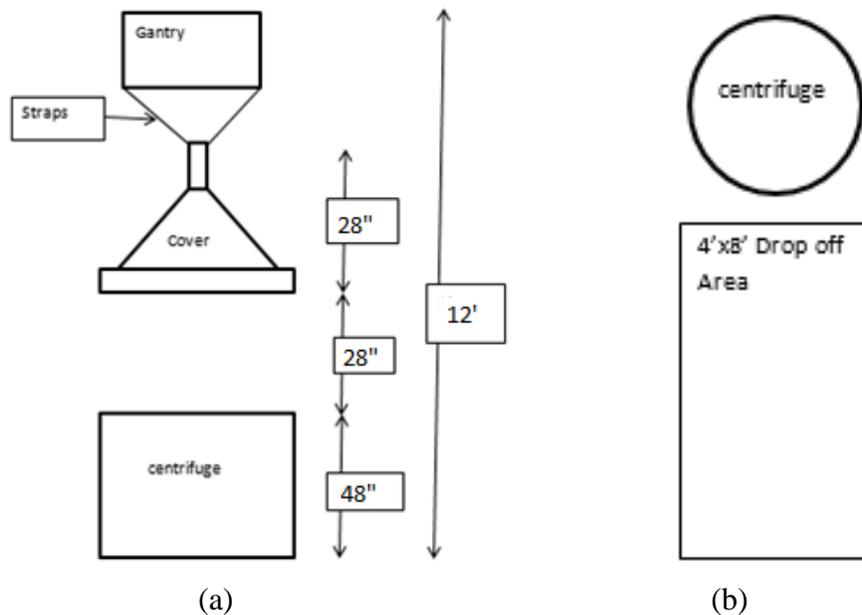


Figure 1: Diagram illustrating initial constraints. (a) Profile view of centrifuge. (b) Overhead view of centrifuge.

The next step was to determine the possible lift system designs and choose the one that best fit the situation. Devils Backbone requested that the lift be powered electronically in the vertical direction and manually in the horizontal direction. Using given constraints, the list of possible lift systems was narrowed to one realistic option. As shown in Figure 2 below, the chosen design utilized a double track system that would support a trolley carrying an electric hoist.



Figure 2: Double Track Gantry Design

Several iterations of the frame and trolley were examined in the design process. As the different options were explored, original thoughts and concepts were modified to accommodate the constraints provided by Devil's Backbone. Certain features were developed to meet specific on-site needs, the prime example being the leveling feet for the frame. These were specifically adapted to ensure successful installation and use of the gantry in the presence of a sloped floor. In addition to incorporating any new details into the SolidWorks CAD drawings, the design team also ran multiple simulations to confirm the structural integrity of the system. The analyses included a friction, motion, and an array of finite element analyses. The list of finite element analyses includes a stress and deformation analysis of both the gantry frame and trolley. A factor of safety was applied to all force studies to ensure that the system would not catastrophically fail even in a worst case scenario. The analyses proved that the final iteration of the design was ready for use and would perform safely in the brewery environment.

From beginning to end, the project provided ample opportunity for both practical answers as well as creative problem solving. The design team was extremely pleased to have worked with a local company and be exposed to a very real problem requiring a real solution. The VMI Mechanical Engineering department is pleased to have the support of local business as it endeavors to produce well educated and qualified students and hopes that the positive relationship cultivated during this project will continue into the future.