TRAIL GROOMER REDESIGN

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ABSTRACT

Pokagon State Park, in Steuben County, Indiana has miles of walking and biking trails with the park property that need continual maintenance, requiring several staff members. A few years ago, a previous design team created a trail groomer (Figure 1) to aid in maintenance, however the sponsor was unable to get the original machine to work.

Figure 1: Old Trail Groomer

Figure 2: Location of Interest: Trail #4

The trails in Pokagon were in disarray due to the elements of weather. The rain and wind had taken an extreme effect on the trails. The trails, mainly gravel, had been blow and washed out by weather. The task assigned to the team was to reuse or create a trail groomer that could simultaneously lay and flatten gravel. The sponsor also expressed interest in the addition of a box scraper to the design.

CUSTOMER NEEDS/SPECS

The Tables 1 and 2 depict the needs and specifications posed by both the sponsor and the team. The needs and specs were created after reviewing the previous design, current trail requirements and several discussions with the sponsor and within the team.

Table 1: Customer Needs

Customer Needs
Must lay a controled amount of gravel
Must flatten gravel into trails
Attach to the back of a John Deere 419 Tractor
Design has box scraper attachement
Device must be maneveruable on trails

Table 2: Target Specifications

Target Specifications
Can hold at least 800lbs of gravel
Fit in a 12"x49"x36"
Attach to tractor via a hitch
Operation is easy and understandable

DESIGN CONCEPTS

The teams' individual members each generated 3-4 concepts for a solution and pitched those ideas to the group. The group then via a decision matrix decided on the best ideas to pitch to the sponsor. The three best ideas were a pull behind brush design (Figure 3). The second design ides pitches was a hopper with a pull behind land scraper (Figure 4-5). Then the final design was a reutilization of the old hopper with a new door (Figure 6). The sponsors chose the final of the designs pitched but wanted to add a box scraper to the back of the hopper.

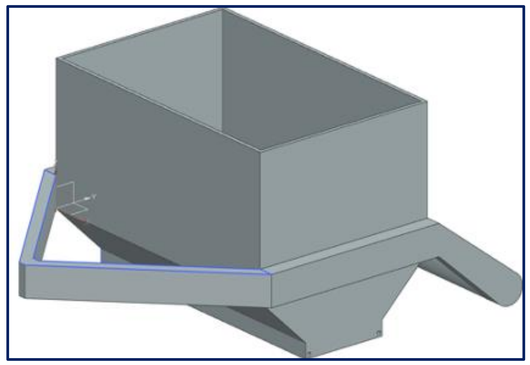
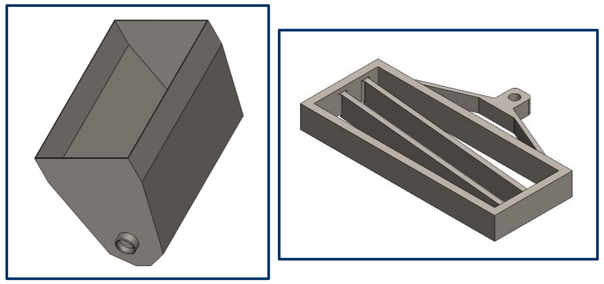


Figure 3: Pull Behind Brush Design



Figures 4-5: Hopper & Box Scraper

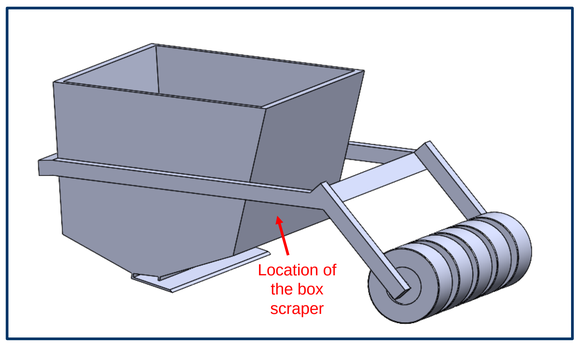


Figure 6 – Reutilization Hopper Design

TEST RESULTS

The group ran two main tests prior to the build of the machine. The tests were FEA analysis of the frame design. The analysis was done via SolidWorks with an 800lb load. Figure 7 shows the stress and Figure 8 shows the displacement. The test results showed the team that the frame would hold up under the target specification force.

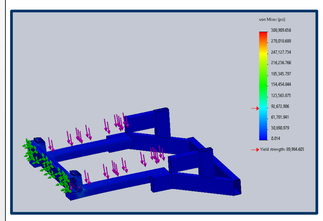


Figure 7 – Stress Test

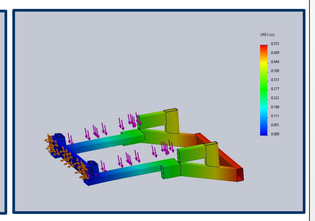


Figure 8 - Displacement

The next test conducted by the students was done after the first build and this was a physical test on the capacity of the hopper and frame. Two groups of three students stood on the assembly to see if the device would hold (Figures 9-10)

Figure 9: Load Testing: Students Standing in Hopper ~450 Lbs.

Figure 10: Load Testing: Students Standing in Hopper ~950 Lbs.

Groomer Construction

Prior to the building of the hopper and frame the team had to accomplish a few things. One being the disassembly of the original hopper and frame. The next step was to mark cut lines on the hopper and frame. Once the lines were marked the team could then start to cut the hopper and frame into pieces. Once the pieces were cut the team had to prep these pieces for welding. This prep included the grinding of the paint off the welding areas; then wiping the welding areas down with acetone. The final step in the build process was to assemble the pieces and weld these together as seen in Figures 11 – 13.

Figure 11 (Top Left) – Holt and Will Cutting Frame
Figure 12 (Top Right) – Drew Grinding Hopper
Figure 13 (Bottom Left) – Will and Travis Welding Frame

FINAL DESIGN

The final design of the project is a trail groomer that will lay gravel in a controlled manner utilizing the hoppers door. The Box scraper is attached to the rear of the hopper design and will spread and flatten the grave from the hopper. The wheels on the hopper will utilize the weight of the hopper and material to help flatten the laid gravel. The design will aid the workers and park goers at Pokagon State Park by helping with the total upkeep of the trails.

Figure14: Final Artifact

LESSONS LEARNED

The group learned multiple valuable lessons from this project including:

- Time Sensitive Project Management
- Team Collaboration
- Welding (MIG)
- Design Problem Solving Skills
- Sponsor Communication
- Major Documentation

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