VIBRATORY FEEDER REDESIGN

Patrick Cahill, Ethan Killeen, Clayton Schenkel, Gage Semple, Joshua Virgil
Design Engineering Technology
Advisor: Dr. Timothy Jenkins

ABSTRACT

The Vibratory Feeder Redesign Team has redesigned an electromagnetic coil vibratory feeder drive unit sponsored by the Moorfeed Corporation in Greenville, Indiana. The unit shown in Figure 1 allows small parts to be raised around the inner perimeter of the bowl using vibrations created from the pull of electromagnetic coils. The team has designed, tested, and developed two vibratory drive units based on customer needs and research inspiration.

Figure 1: Original Moorfeed Design

CUSTOMER NEEDS

Moorfeed asked the team to develop a redesigned drive unit that would reduce leaf spring binding, improve maintenance and manufacturing, and lower weight. Table 1 lists the main customer needs and specifications.

Table 1: Needs and Specifications

Customer Needs	Related Specifications
Efficiency	Maintain original design effectiveness of 100 parts/min
Manufacturability	Simplistic components with standard fasteners
Ease of Maintenance	Components do not create complex subassemblies
Weight Ratio	~3:1 weight ratio between base and bowl

DESIGN CONCEPTS

Design concepts focused on solving the customer needs. Figure 2 is the Notched-Base design, utilizing a base that would hold the springs without lugs. Figure 3 is the Compact design, which only used one electromagnetic coil and three leaf springs. Figure 4 is the Slot-Modular design focusing on easing maintainability. Figure 5 is the Tangential-Ring design, replacing the cross-arm.

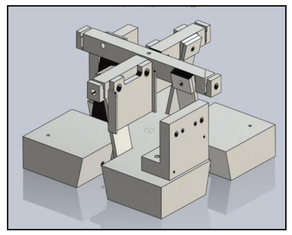

Figure 2: Notched Base Drive

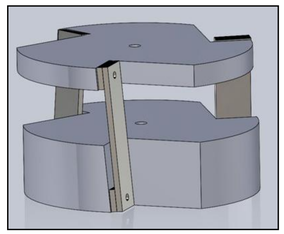

Figure 3: Compact Drive

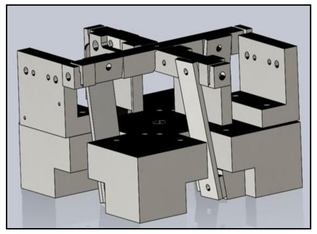

Figure 4: Slot-Modular Drive

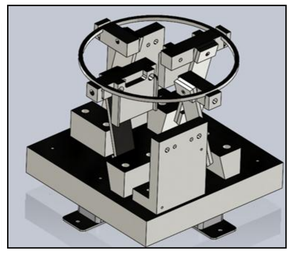

Figure 5: Tangential-Ring Drive

PROTOTYPES

From the chosen concepts, the team created two prototypes during the design phase to illustrate the designs, Figures 6 and 7. Prototypes are 3D printed using PLA.

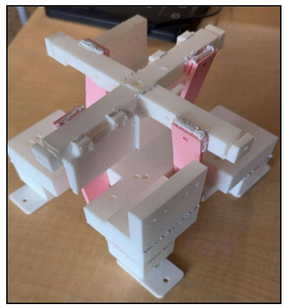

Figure 6: Slot-Modular

Figure 7: Compact

FINAL DESIGNS

The final designs were chosen after considerations between the customer and the team, finalizing on developing two team-chosen designs to move forward with. The first design, Figure 8, is the slot-modular drive unit, made to ease manufacturability, maintenance, and allow reversibility for different applications.

The second in Figure 9 is the simplistic compact drive unit, made to reduce its volume and weight while still generating effective power to the bowl.

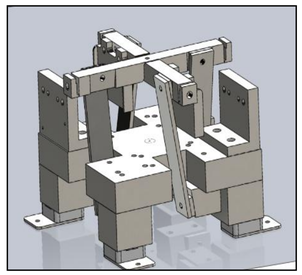

Figure 8: Slot-Modular Final Design

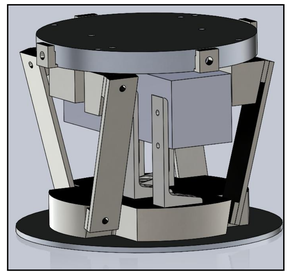

Figure 9: Compact Final Design

TEST RESULTS

Using Finite Element Analysis, the team inspected the units for possible areas of failure. Harmonic testing was used as the drive unit experiences high vibrative forces, which may cause fatigue in the structure overtime, leading to binding in the springs. Figures 10 and 11 show these results.

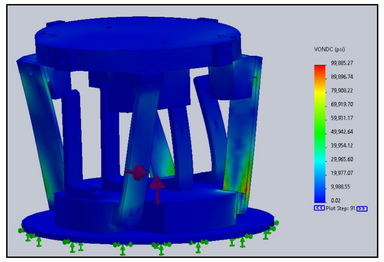

Figure 10: Compact Harmonic FEA

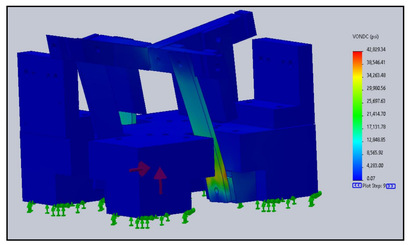

Figure 11: Slot-Modular Harmonic FEA

FABRICATION

The team was able to fully fabricate the slot modular design for final real tests. Figures 12 and 13 show some work.

Figure 12: Cross-arm Milling

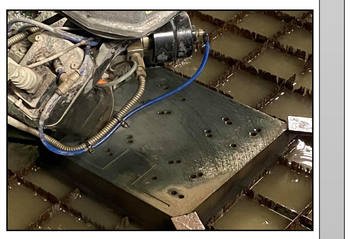

Figure 13: Slot-Mod Base Waterjet-Cutting

CONCLUSION

The Vibratory Feeder Redesign team learned how to design, prototype, and fabricate original concepts using the materials and information provided from the sponsor Moorfeed and Trine University. The vibratory drive units displayed in Figures 14 and 15 show the efforts and skills of the members of the team, through teamwork, designing precision parts, fabricating components using machining equipment, and problem-solving when faced with challenges.

Figure 14: Final Slot-Modular Assembly

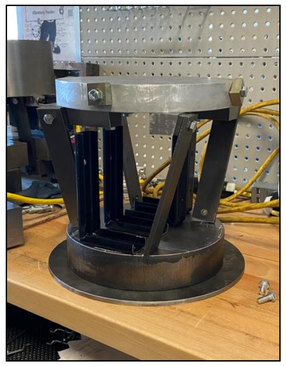

Figure 15: Final Compact Assembly

LESSONS LEARNED

The Vibratory Feeder Redesign team learned plenty of lessons throughout the project.

- Precision designs require extensive planning and testing to produce a functional machine
- Vibration units use tuned frequencies and amplitudes to create needed movement
- Communication is one of the most important aspects of teamwork

ACKNOWLEDGEMENTS

The team would like to acknowledge the following who helped support and guide this project:

- Mr. Brian Bego - Sponsor Representative – Moorfeed Corporation
- Mr. Timerson Downing, Project Manager, Innovation One
- Design Engineering Technology Department