Motorcycle Gearbox Redesign

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ABSTRACT

Replica Motorcycle Parts sponsored this re-design of the 1973-76 Honda CR250R motorcycle gearbox. These vintage bikes are still a favorite for riders and racers. However, the original gearbox has known flaws between 3rd-4th gears and 4th-5th gears. Replacement parts are now difficult to find. With the support of Replica Motorcycle Parts and other local organizations, the team addressed the design flaws to improve gear wear and overall shifting performance. The design was then optimized for metal 3D printing technologies to make the products more accessible and affordable.

Figure 1: Full transmission

CUSTOMER NEEDS/SPECS

1. Complete drop-in gearbox of 1975/76 Honda CR250M
2. Design Changes to main shaft 3rd gear and shifter valleys
3. Additive metal 3D printed parts
4. Added ribbing to the shifter forks for better shifting

Figure 2: 10180-00-01 dog gear

REVERSE ENGINEERING

- Helmel PcMM used to analyze 3rd gear dog gear.
- Starrett EZ300 Vision System used to measure the Shifter forks, all gears, radii, and diameters.
- Calipers & micrometers were used to measure all parts.
- SolidWorks: Solid models and drawings

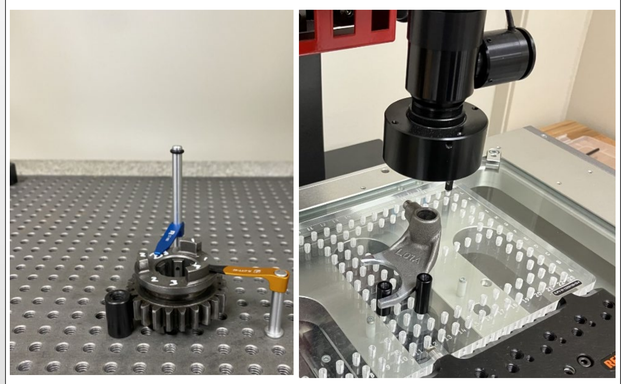

Figure 3: CMM and Vision System

FINAL DESIGN

- Added a 1.5-degree sweep on the dog gears for better engagement
- Extra ribbing added to the shifter forks
- Parts machined to size after printing
- Plastic gearbox created to show internal parts moving
- SolidWorks models and drawings were created

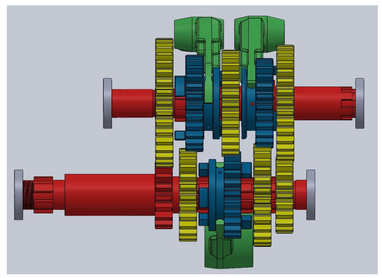

Figure 4: CAD gearbox assembly

PROTOTYPE

The team started prototyping by creating CAD models and verifying that they fit within the factory specifications. After this, the models were compared to information provided by Auburn Gear using their Gear Pro software which creates a profile based on center distance, number of teeth, and outer diameter. Next, models were printed in plastic and compared to the original parts.

ADDITIVE

- Renishaw AM400 Metal 3D printer
- Material: 316 Stainless Steel
- Printed at 170 degrees Celsius in a zero-oxygen chamber with Argon
- Build Plate #1 took 27 hours
- Build Plate #2 took 19.5 hours

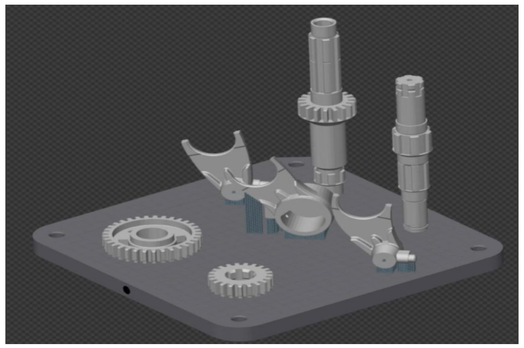

Figure 5: Build plate #1

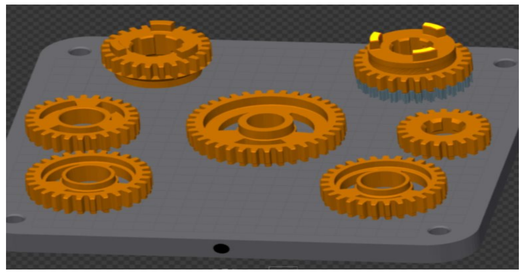

Figure 6: Build plate #2

CONCLUSION

The team learned that it is currently not economical to metal 3d print parts for manufacturing due to part geometries and tolerancing. Three quotes were received at $11,000 for printing only which was 10 times over the estimated budget. Upon that discovery, the below was obtained and completed.

1. Plastic gearbox and case for display
2. 3D drawings and machining drawings
3. 316 Stainless steel display parts. Donated by Elmet Technologies
4. Part files and drawings for 3D additive manufacturing

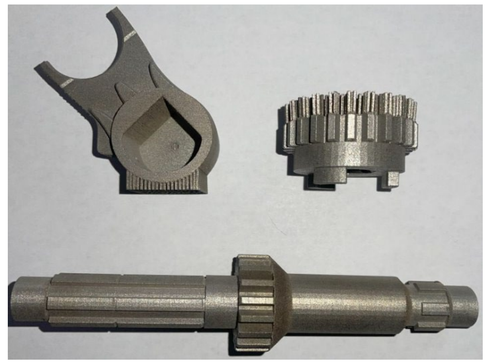

Figure 7: Metal 3D printed shaft, dog gear, and shifter fork

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