

Original Objectives

- Design a lightweight gearbox suitable for the current Mini Baja vehicle.
- Design within the packaging and integration constraints of the vehicle.
- Develop CAD models and detailed drawings of all components.
- Perform necessary analysis to support the design of gears, shafts, etc.
- Build an alpha prototype and integrate in the vehicle.
- Test the vehicle with the new gearbox.

Requirements

- Develop a drop-in gearbox. This requirement was not met due to COVID-19 as we were not able to complete the gearbox.
- Reduce mass of gearbox by 20-40% from old gearbox. This requirement was not met due to COVID-19. We were not able to complete the gearbox and therefore could not test the weight against the old gearbox.
- ✓ Make a compact gear ratio near 10:1.
- ✓ Design gearbox for max speed of 25 mph.
- ✓ Design with simplicity and current constraints in mind.
- ✓ Design with durability and fatigue life targets.
- ✓ Meet Mini Baja vehicle requirements.

Concepts

- Concept 1: Gearbox the same as old gearbox but scaled down for 10hp.
- ✓ Concept 2: Simple gearbox with one forward gear.
- Concept 3: Gearbox with one forward and one reverse gear.

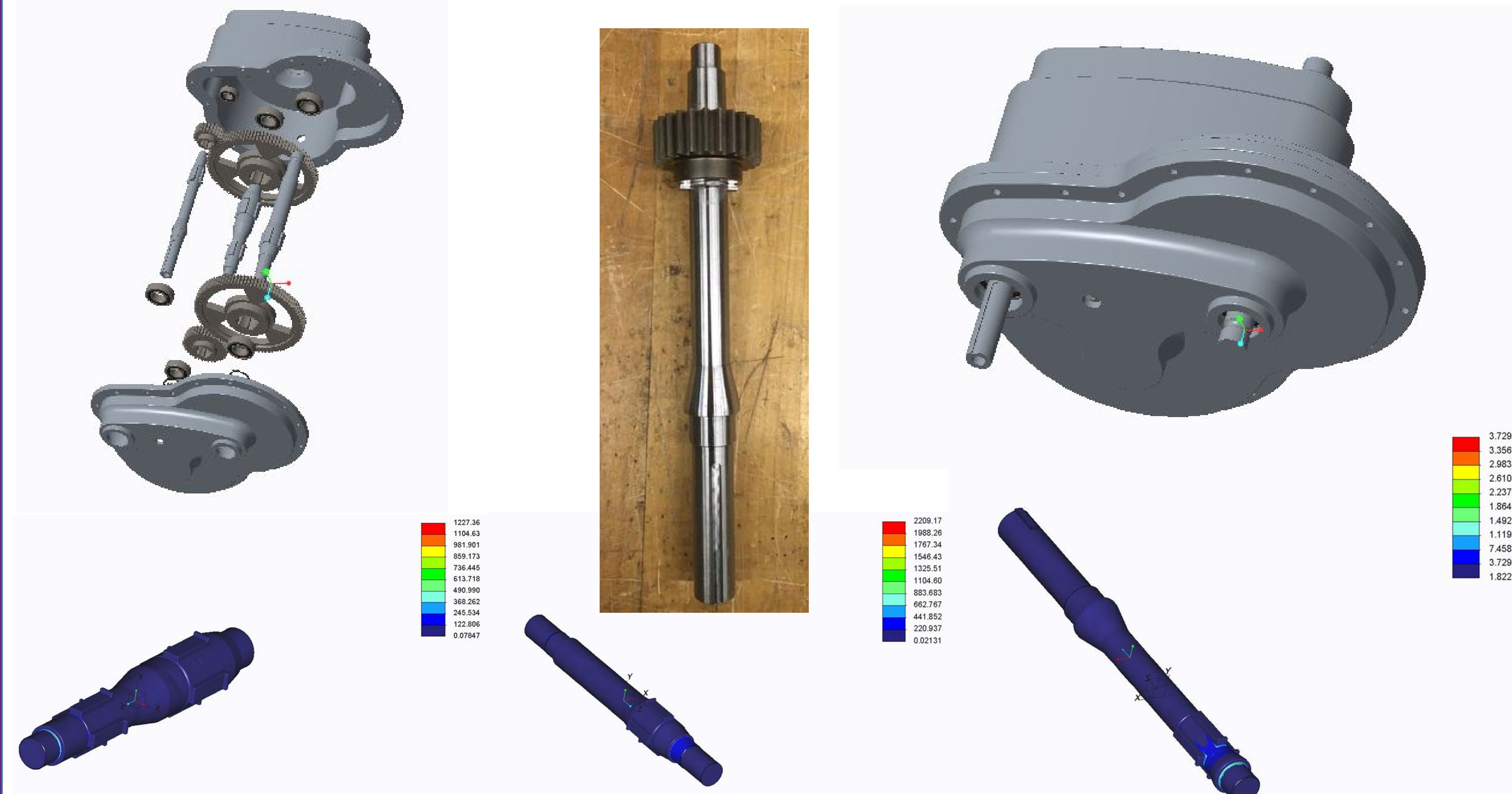
Concept 1	Concept 2	Concept 3
6	13	11

Problem Statement

The SAE Mini Baja team at Western Carolina University needs to upgrade their vehicle with a custom-made gearbox. The new gearbox will replace the off-the-shelf gearbox. The new gearbox must follow all rules and guidelines issued by SAE for the 2020 competition. The new gearbox also needs to integrate with the current vehicle drivetrain and the available spacing in the roll cage. The gearbox needs to be designed as per the power and torque curves of the Briggs and Stratton 10 hp Intek Model 19 engine. All parts need to be designed for 10^6 cycles. The design needs to be supported by simulations and analytical results. Complete drawings and CAD models need to be developed for all the parts of the gearbox.

Final Design/Results*

- The final design was chosen to satisfy the need for simplicity, low weight, and required durability.
- Gears were purchased off-the-shelf from KHK gears and then modified by Daystar Machining to reduce weight. Features were added to the gears for assembly.
- Three shafts were designed and machined by Daystar Machining.
- Two case halves were designed by the team the blanks were machined by Daystar Machining.
- All parts were designed for infinite life and CAD models were used for analysis and simulation through Finite Element Analysis (FEA).
- The case halves have not been fully machined. Blanks have been partially machined and machinist notes have been left on drawings for future completion.



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

Modified Objectives*

- Due to COVID-19 the gearbox could not be completed and tested.
- The case halves could not be fully machined, so complete machining drawings were developed.
- Since the gearbox was not completed and could not be tested, FE analysis has been completed to support the final design.
- Complete fixture design has been developed to support the final machining of the two cases.
- A complete parts list has been developed to support future efforts to complete the manufacturing and assembly of the gearbox.
- Since the integration into the vehicle could not be completed, assembly notes have been developed to guide the final assembly of the gearbox.

Summary

- The team successfully designed a gearbox for the vehicle that matches the torque requirements and the desired vehicle speed.
- The team was successful in analyzing all components and manufacturing all parts.
- The team learned valuable lessons in project management. The team also learned how to adapt to completely unforeseen circumstances such as COVID-19.

Team & Acknowledgements

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