Orion Miller 2018 Custom Steering Rack Report April 21st, 2018.

**Background**

In the teams most recent car (GRC-17), a Kaz Technologies steering rack is used in a bottom mount, rear steer configuration. This rack is reliable and functions well, however when scrutinizing the overall weight of the system, there appear to be opportunities for improvement.

Firstly, the location of the mounts on the rack created the need to add two more frame members through the middle of the cockpit floor. The weight of these tubes is estimated to be 441 grams (0.83 lbs). If a slightly longer rack were used, it would be possible to avoid this by mounting on to the existing outside frame members.

Secondly, a different material could be chosen for the rack gear. Using aluminum over steel would reduce weight significantly for such a large component. The density of steel is 7700 kg/m3, whereas aluminum is only 2700 kg/m3. The reason aluminum is less commonly used is because aluminum gears are prone to galling. However, the life cycle of an FSAE car is quite short, and the weight reduction benefits are large enough to justify the inconvenience of possibly having to replace the rack gear on a yearly basis.

**Design Goals**

Because of the lack of available steering racks that are designed to mount on the outside of the frame, are lighter than the Kaz rack, and are affordable, the development of a custom rack is the best option. The requirements for this design are as follows:

Constraints

* This rack should have a similar speed ratio (4.8 in/rev) and overall travel (3.25”) to the previous system, because the team was satisfied with its performance.
* The journal bearings should be mounted on the outside of the system to minimize the lengths of the bending moments for the longer rack gear.
* The housing of the system needs to effectively keep the grease in, and any dust or dirt out.
* The system needs to be built to withstand estimated maximum steering forces of 2000 N.
* Because reliability is critical for a steering system, all components must be designed for a factor of safety of 1.5 or greater.

Criteria

**Development**

­Checking the geometry of the frame in CAD, the outside frame members are around 320 mm apart in the section where the system would be mounted. If brackets are attached on the immediate inside of these tubes, a distance between mounts of 300-305 mm should be suitable.

A pinion gear with a speed ratio of 4.8 in/rev from a previous year’s steering rack was selected.