Davis Moore

Introduction Draft

In the highly competitive world of Formula One only the best suspension and frame designs are used. There is a standard procedure used in most designs, first the team discusses the objectives of the car, then the frame design, and finally designs each system separately [1]. After the designs are done, the car is modeled in CAD or Solid Works and Finite Element Analysis is performed to test for weaknesses. Adherence to SAE guidelines and requirements is necessary and should always be an important task when designing anything in the car [1-3].

The only question left unanswered is what a modern student formula car should include, within a budget of $10,000 - $15,000. There are guidelines relating to older methods and materials but there is a void between older student projects and new, constantly evolving professional cars [1-3]. In professional Formula One there is exclusive use of carbon fiber monocoque for the frame fabrication [4]. There are also studies proving the validity of new composites, such as carbon fiber for use on the suspension, that can dramatically increase performance and lower weight [5].

From all research a push rod suspension seems to be the obvious choice for any formula car due to aerodynamics, relative simplicity and diversity of cost, due to multiple materials [1-3]. A carbon fiber monocoque would be ideal, but due to fabrication and budgetary constraints a chromoly or possible aluminum frame will be used [4]. Composites could be used when fabricating the push rod suspension, but the materials will be chosen after design is finished and a cost benefit analysis can be done to determine if the materials will be worth the increased price [5]. Therefor the purpose of the project was to identify a cost effective frame and suspension design.

**References**

[1] R. Capitani, T. Iacomelli, D. G. Rosti, and P. Tozzi, "Design for X approach to optimise a formula SAE car," in *Proceedings of the 7th Biennial Conference on Engineering Systems Design and Analysis - 2004, July 19, 2004 - July 22, 2004*, Manchester, United kingdom, 2004, pp. 475-481.

[2] A. Mihailidis, Z. Samaras, I. Nerantzis, G. Fontaras, and G. Karaoglanidis, "The design of a Formula Student race car: A case study," *Proceedings of the Institution of Mechanical Engineers, Part D: Journal of Automobile Engineering,* vol. 223, pp. 805-814, 2009.

[3] W. B. Riley and A. R. George, "Design, analysis and testing of a Formula SAE car chassis," in *Motorsports Engineering Conference and Exhibition, December 2, 2002 - December 5, 2002*, Indianapolis, IN, United states, 2002.

[4] M. D. Gilchrist and L. Curley, "Manufacturing and ultimate mechanical performance of carbon fibre-reinforced epoxy composite suspension push-rods for a Formula 1 racing car," *Fatigue and Fracture of Engineering Materials and Structures,* vol. 22, pp. 25-32, 1999.

[5] G. Savage, "Sub-critical crack growth in highly stressed Formula 1 race car composite suspension components," *Engineering Failure Analysis,* vol. 16, pp. 608-617, 2009.