

Modeling and Analyzing of an Automobile Roll Cage (SAE Baja)

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ABSTRACT: BAJA SAE is an all terrain vehicle competition which gives under graduate students a practical experience in engineering sciences. In this event we can get more practical knowledge in automobile field. This project deals with modeling of roll cage of an automobile (SAE BAJA) and analyzing it to give an optimum design. BAJA is most economical off- road vehicle can be used in rugged environment, so we should analyze the impact forces of terrain environment. Ergonomics and aesthetics of the vehicle should also be taken into account. Roll-cage design is made with the help of solid works software. Roll-cage is the primary defense against roll over and other unknown accidents happening in the terrain environment. We should analyze impact resistance of roll-cage design under various conditions like front impact, self weight impact during jumping over uneven surface and endurance in varying road conditions. While considering safety ergonomic condition, comfort of driver and aesthetics are also taken into account. This makes roll-cage economic and efficient one.

Main theme of the project is to find non concurrency in production of a product. It deals with non concurrency in designing and manufacturing of automobile roll cage. And rectifying it to meet a optimal design and manufacturing sequel in manufacturing a product.

KEYWORDS:SAE BAJA, ergonomics, aesthetics, impact, roll-cage, concurrent engineering.

I.INTRODUCTION

The design process of this single-person vehicle is iterative and based on several engineering and reverse engineering processes. Following are the major points which were considered for designing the off road vehicle:

1. Endurance
2. Safety and Ergonomics
3. Market availability
4. Cost of the components
5. Standardization and Serviceability
6. Maneuverability
7. Safe engineering practices

II.DESIGN METHODOLOGY

Modeling of roll-cage is done with consideration of safety and aesthetics. All specification mentioned in SAE rule-book is taken into consideration. Designing of roll cage is done with ergonomic and safety conditions as specified in SAE rule book.

III.COMPONENTS OF ROLL CAGE

Roll cage consists of primary and secondary members

Primary Members

- Rear roll hoop member
- Rear hoop overhead members
- Front bracing member
- Lateral cross member
- Front lateral cross member

Secondary Members

- Lateral diagonal bracing
- Lower frame side
- Side impact member
- Fore/ aft bracing
- Under seat member
- All other required cross members
- Tube to mount safety seat belts

IV.DESIGNING PROCESS

- Designing reference model
- Doing modification in reference model
- Changing the model according to suspension and steering mechanism
- Changing design clearance after prototype
- Analyzing the finalized design
- Comparing the difference between former and later design
- Finding solution in reducing fault in designing process.

V.REFERENCE MODEL

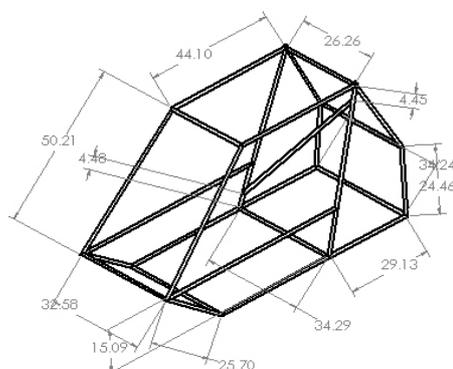


FIGURE 1: Isometric View

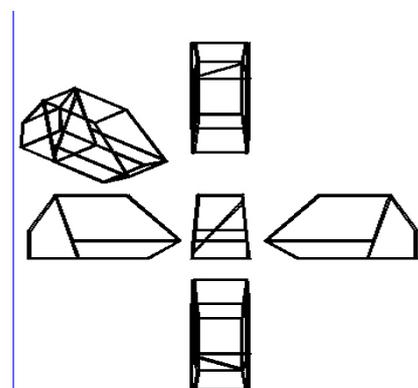


Figure 2: All Views

VI. MODIFIED MODEL

Trial 1
Trial 2

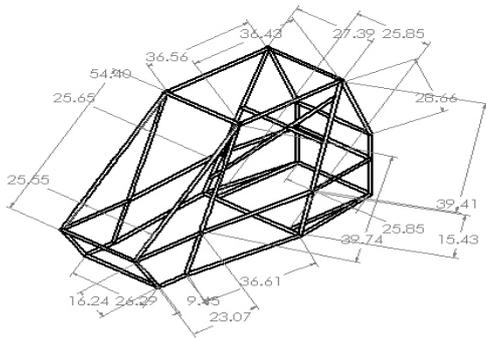


Figure 3: Trial 1 of Modified Model

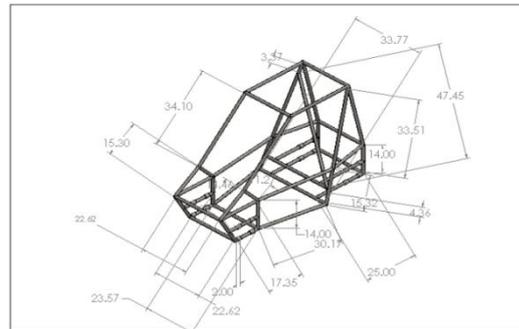


Figure 4: Trial 2 of Modified Model

VII. FABRICATION OF PROTOTYPE MODEL

With the help of designed model we planned to build a prototype in PVC to find feasibility in manufacturing roll-cage without any difficulties. PVC pipes are cut to required dimensions as per the designed roll-cage model.



VIII. ANALYSIS

Baja is a all terrain vehicle hence following impact forces should be taken into account. By analysing the following impact force we can get a safe design and analysing it for various materials optimised model can be achieved.

Front Impact

Rear Impact

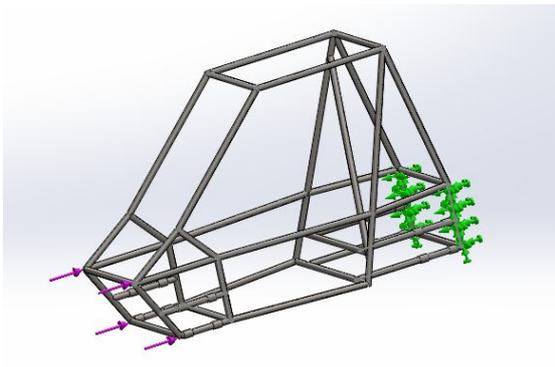


Figure 5: Front Impact

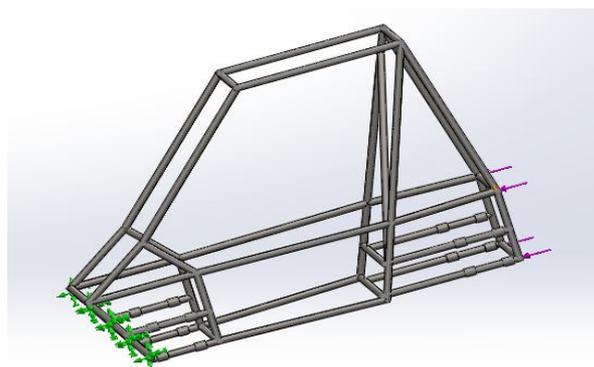


Figure 6: Rear Impact

Side Impact

Roll Over Impact

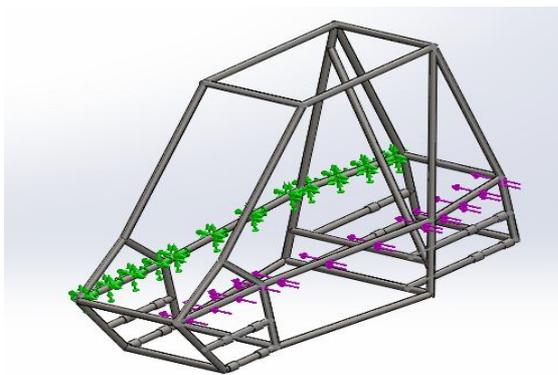


Figure 7: Side Impact

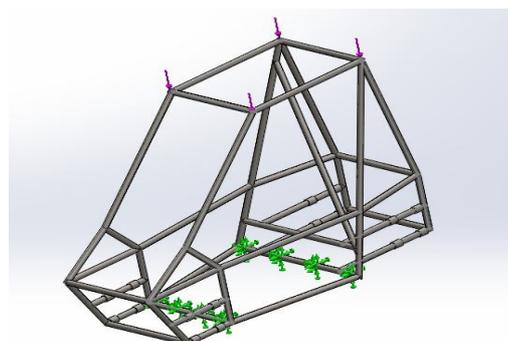


Figure 8: Roll Over Impact

Front Wheel Landing Impact (Jump)

Rear Wheel Landing Impact (Jump)

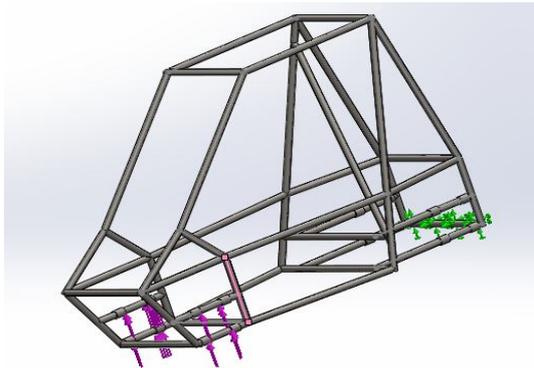


Figure 9: Front Wheel Landing Impact

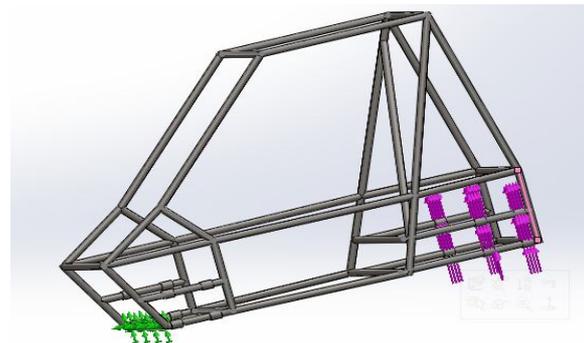


Figure 10: Rear Wheel Landing Impact

IX.CASE STUDY

In our project we came across a problem in fabricating of prototype in PVC. The problem is we cannot create angles as per the designed specification. So every designing should be done with consideration of manufacturing and assembly in mind. We have difficulties in manufacturing prototype hence we rectified all the difficulties in manufacturing prototype and redesigned the design which is formed earlier.

X.REVIEW AND DISCUSSION

While designing the project we simply design with specification given in SAE BAJA rule-book. After when it comes to manufacturing it meets some difficulties of real time scenario. For example bolt misalignment to the holes which are designed for temporary joint. We meet practical difficulties like problems in manufacturing a designed model as it is. The problems arise when there is no manufacturing process which would suit the design model, or practical difficulties in assembling designed parts. Most automobile industries use lean and just in time manufacturing while using this procedures they will not tolerate these condition in product production. Hence concurrent engineering should be applied in order to reduce time waste in redesigning model after it is send to manufacturing plant and altering product after difficulties in assembly procedure. Hence these problems should be discussed before designing process is started.

XI.CONCLUSION

The project comes out with an economic and efficient model. This consists of roll-cage analysis results and prototype which can be further modified to give a real model which can endure in all terrain conditions. By doing this project came to an idea that each and every process in completion of product or production of project comes with the help of concurrent engineering. Interconnection lies between each and every department in organization. So every nook and corner of each process in production of product is to taken into consideration while planning itself and a special committee is to be set. This committee consists of members in each field of expertise.