

Value Analysis of Upright for an All-Terrain Vehicle

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Abstract - Value analysis defines a process in which the value of the product can be increased by significantly decreasing its cost to achieve a long-term profitability plan of a company. In this study, Value analysis Job Plan has been used to reduce the cost and improve value of Steering Upright.

An Upright is a component in the wheel assembly of the vehicle which supports the tie rod, brake caliper, & wheel to give stability. In this work the upright is designed for good factor safety and then manufactured using CNC machinery.

The upright is modeled and analysed in solidworks software. Then the estimated cost for manufacturing is obtained. The model and material is modified based on the value analysis.

Keywords: Upright, Factor of safety, Value analysis, C-45, Al-6082-T6,

1. INTRODUCTION

The Steering Upright in the wheel assembly is a joint that provides the front wheel to turn at certain angle to control the path of the vehicle. The upright can be in different sizes and shapes based on the application and load criterion. The shape of upright mainly depends upon two types of suspension system chosen i.e. Double wishbone and Macpherson strut. The components like brake calipers, tie rod, ball joint, upper arm and lower arm will be connected to upright hard points. The wheel is connected to it based upon hub and spindle. For good performance of vehicle, we have to reduce the un-sprung mass, which includes 90% of wheel assembly weight. The lighter steering upright resulting greater power and less the vibration because of the inertia is less.

The steering upright carries the power thrust from tie rod to the stub axle and hence is must be very strong and rigid. The upright is designed based upon the parameters like kingpin axis inclination angle, caster angle, distance between upper and lower hard points and steering upright position. Value analysis methods are very important and useful in Cost Reduction and sustain their profitability. Value analysis is one of the most effective techniques available to identify and eliminate unnecessary cost in manufacturing processes, design, test, construction, maintenance, data specifications and practices. Although its application to procedures, specifications and practices is less well known, its effectiveness in these areas has been proven. Value analysis is a systematic approach to direct and analysing function of equipment, services, systems and supplies for the purpose of achieving their essential functions at the lowest cost with required reliability, performance, safety and quality.

2. PHASE 1:

We began the process of manufacturing the upright by selecting a material. After selecting the material we designed and analysed it. Then the cost was estimated based on the manufacturing method.

Material Selected: Aluminium alloy

Properties of Al alloy:

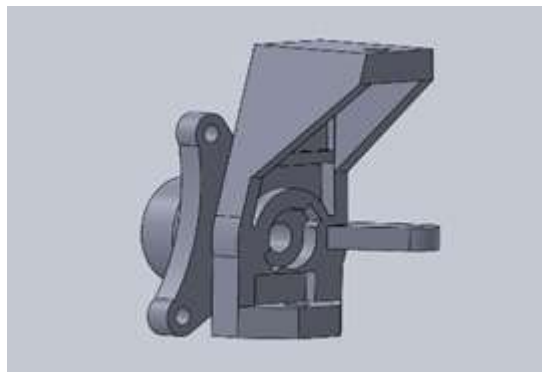
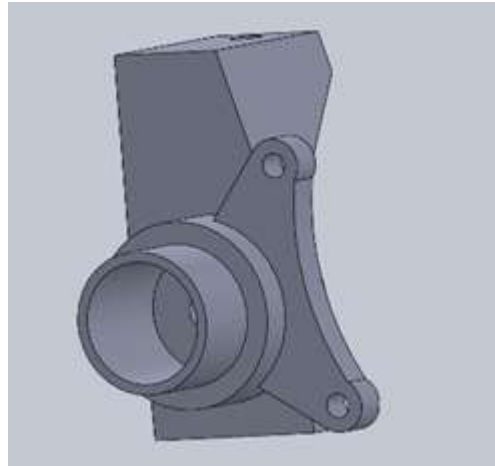
The properties of alloy material are as follows:

- Density = 2710 kg/m³.
- Tensile yield strength = 270 MPa.
- Ultimate tensile strength = 330 MPa.

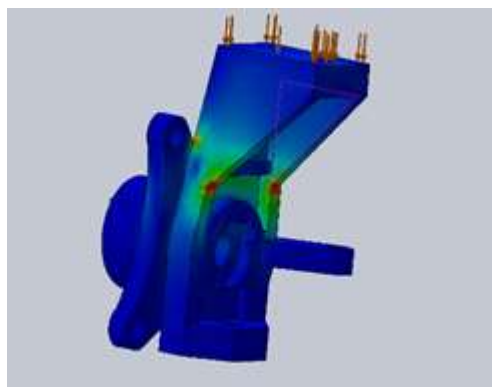
- Young's modulus = 71 GPa.
- Shear Modulus = 26 GPa.

2.1 Modelling-

The upright was modelled in Solid works and then the analysis was carried out by applying the right forces and moments. During modelling the king pin inclination was taken as 9 degrees. The holes provided for suspension A-arms are of 12mm diameter and of steering is of 10mm diameter.



The analysis was carried out in solidworks.



2.2 Cost for manufacturing-

Material cost – 300Rs per kg

Material weight- 11kg

Final product weigh- 6kg

Total cost of raw material – 1800Rs

Machining cost- 3400Rs

Labour cost – 5000Rs

Total cost- 10200Rs

3. PHASE 2:

Material selected: C-45

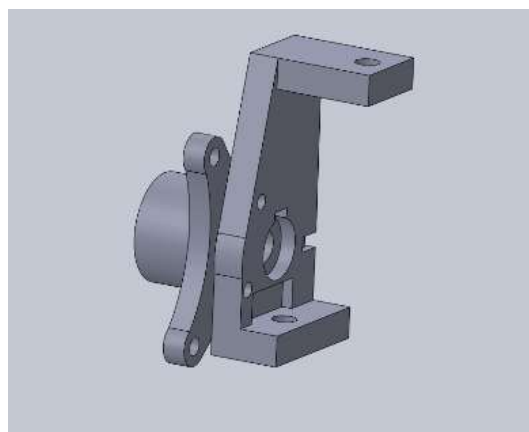
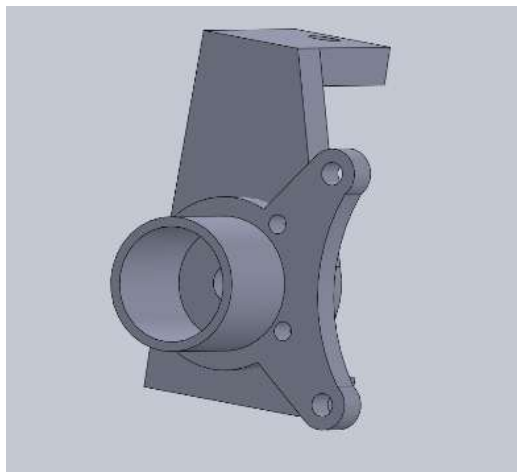
Properties of C-45:

The properties of material are as follows:

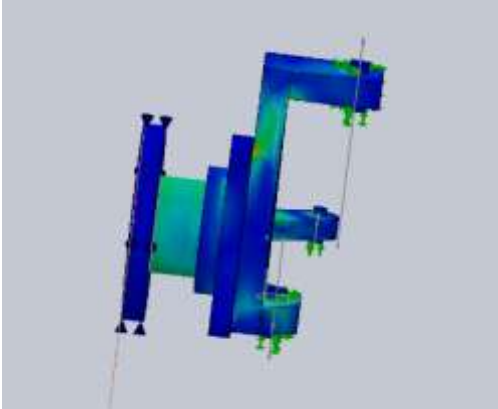
- Density = 7850 kg/m³.
- Tensile yield strength = 400 MPa.
- Ultimate tensile strength = 600 MPa.
- Young's modulus = 190 GPa.

3.1 Modelling -

The upright was modified minimizing all the faults that we faced in the previous case.



Same calculations and forces were used for analysis.



3.2 Cost of manufacturing -

Material cost- 80Rs per kg

Material weight- 10kg

Final product weight- 4.9kg

Total cost of raw material- 800Rs

Machining cost- 3000Rs

Labour cost- 5000Rs

Total cost- 8800Rs

4. EVALUATION AND IMPLEMENTATION

The material initially selected is Al alloy and it had a cost of 300Rs per kg. C-45 was then selected because of its cost as it is 60Rs per kg. The other reason why we chose C-45 is because it is a tempered steel and it can be hardened. The second thing which was implemented is material reduction. Material was reduced in order to ease the machining processes. It also resulted in reduction of weight of the upright, the manufacturing time and total cost.

5. CONCLUSION

From this Case Study it is observed that how the value analysis is used for the material selection and cost reduction. It also helped us in product design by material reduction thereby reducing manufacturing time as well. The Value analysis process and procedures are generally well defined and well-understood at all levels in the industry. It is effective and influential on the performance, quality, and cost of a product when done relatively early in the production schedule.

6. REFERENCES

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