Technical Analysis

Name

Date

Project Name

# Introduction

The project is to develop a robot which can stabilize itself in all the directions and move on the rough terrains and create a good balance over the rough terrains as well. For this purpose, the team is designing a two wheeler robot which can move around and balance in all the terrains.

For this paper I am doing the analysis on the shaft using in between the wheels to support the whole chassis as this shaft should be strong but another important aspect is that it must be light in weight so that the overall weight of robot will have to be low. So two types of shaft we have here, one is hollow shaft and other is solid shaft. From both types the best will select according to the strength and weight ratio.

# Assumptions

Assumption for the shaft calculations

1. Radius of outer side of shaft is
2. Radius of inner side of shaft is
3. For both the hollow shaft and solid shaft the allowable shear stress is same.
4. Formation of polar angle

# Equations to use

The equations which are going to use in this analysis are

So

* T = torque in shaft,
* = polar form of moment of inertia
* = radial distance

Equation for the ratio of weight

So

* g = gravity
* weight for hollow shaft
* = outer radius
* L = length
* weight for solid shaft

Hollow shaft strength to weight ratio

So

* L = length
* = outer radius
* g = gravity

Solid shaft strength to weight ratio

So

* L = length
* = outer radius
* g = gravity

# Physical Modeling

In order to actually perform the physical modeling, it need to use the hollow shaft and solid shaft in real to test the strength and strength to weight ratio.

# Governing Calculations

Starting with the explanation that solid shaft must be heavier than the hollow shaft so let’s calculate the equations as

Calculate the maximum shear stress [2].

Weight ratio calculated as

From the above equation is hollow shaft weight and is solid shaft weight and as the ratio is less than 1 that means hollow shaft weight is less as compare to solid shaft that is the reason ratio is less than 1. Now calculate the strength to weight ratio

Hollow shaft ratio

So the equation gives

Values inserted into the equation

Solid shaft ratio

So the equation is

Values inserted into the equation

Strength to weight ratio has large value for hollow shaft, while strength to weight ratio has low value for the solid shaft, it means solid shaft has higher weight and less strength to weight ratio so it is better to use hollow shaft.

# Conclusion

The team is working on a design project of robot and they are developing a two wheeler robot which can balance itself on a rough terrain as well. In this analysis, shaft has analyzed which is using in between the wheels, so from two types of shaft hollow shaft and solid shaft the best is hollow shaft because of light weight and higher strength to weight ratio. This analysis is helpful for the team in designing the project specifically for the shaft designing so the final shaft has selected so the team will simply put that directly into the design without any brainstorming.

# References

[1] J. jack, K. noel, “Mechanical Analysis Shafts” ,9th edition chapter 7 shafts. http://www.staff.city.ac.uk/~ra600/ME2105/Analysis/ME2104-A-1.pdf

[2] J. Wick, “Shaft Designing”, available [online], https://fac.ksu.edu.sa/sites/default/files/fatigue-chap9-rev-1-part4.pdf

[3] F. Naik, “Failure Analysis of Machine Shaft”, available [online], https://www.efficientplantmag.com/2012/07/failure-analysis-of-machine-shafts/