ME220
ASSIGNMENT 3: FAILURE ANALYSIS
GORILLA TRIPOD

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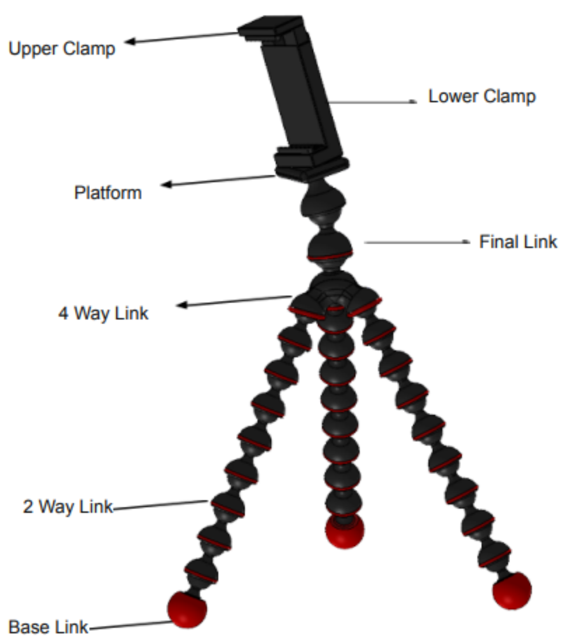
EXECUTIVE SUMMARY:

The object chosen is a Gorilla Tripod.
Failure Modes and Effective Analysis(FMEA) has been on the Gorilla Tripod. Failure Modes which include slippage of joints, mechanical failure, the popping of joints, etc. are first detected and then analyzed to make improvements to overcome them.
The severity, occurrence, and detection of the failures have been estimated and RPN values were calculated to find the amount of failure in the Gorilla Tripod.

Stress analysis was subsequently carried out on Ansys, after which regions of critical stress concentrations were identified and then analyzed more closely. Results corresponding to the safety factor, equivalent Von-Mises stress, and Total Deformation were procured.

Based on these results, the design was assessed and improvements were suggested.



Gorilla Tripod

FMEA for Gorilla Tripod

Sr. No	Potential Failure Mode	Potential Failure Effect	Severity	Potential Causes	Occurrence	Detection	RPN	Suggestions and Measures
1	Slippage of joints	Unstable Tripod causing hindrance	3	Wearing	6	4	72	Using more suitable material/finish at joint
2	Popping of joints	Separation of links	4	Too much tensile force while adjusting tripod	3	1	12	Improvement of manufacturing quality
3	Mechanical failure of the joint between platform and body	Essentially rendering Tripod useless if the phone can't be fixed onto it.	8	Falls and other impacts	2	1	16	Tougher joint design
4	Failure of the clamp spring	Effectively no grip to hold the phones stable	8	wearing	7	2	112	Use of higher quality springs
5	Slip of base	Unstable Tripod	4	Less coefficient of friction between the slippery surface and base link (with smooth material)	8	4	128	Addition of Silicon/rubber layer/ grooves around the base link for better grip

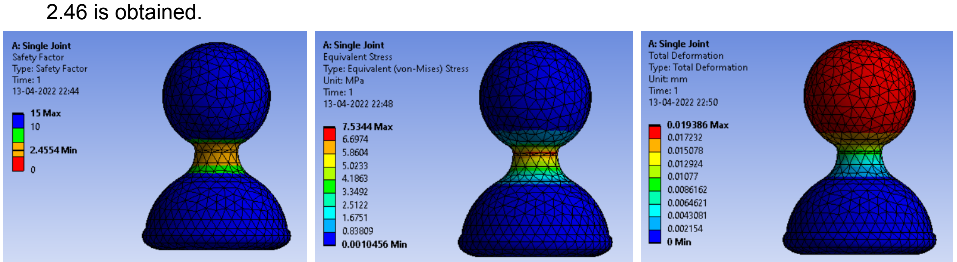
STRESS ANALYSIS

Since the functioning of the selected model is mainly in static conditions, only static structural analysis has been performed using finite element method on Ansys. Minimum Safety Factor in the model (in perfectly upright position) with a phone weighing 200g greater than 10. However, regions of potential mechanical failure were found. From the stress analysis of the entire model, it is apparent that there are stress concentrations in 3 parts, namely links, clamp base, and body (following the previous nomenclature). The model was meshed and appropriate boundary conditions were applied to get results on equivalent Von-Mises stress and deformation. The boundary conditions were applied to get an upper limit of functioning, i.e. loading in which safety factor approaches 2. Following are the critical parts in which mechanical failure is more likely to occur. Note that the failures correspond to abnormal use, for example, if the object is dropped or stepped on:

1) **Link**

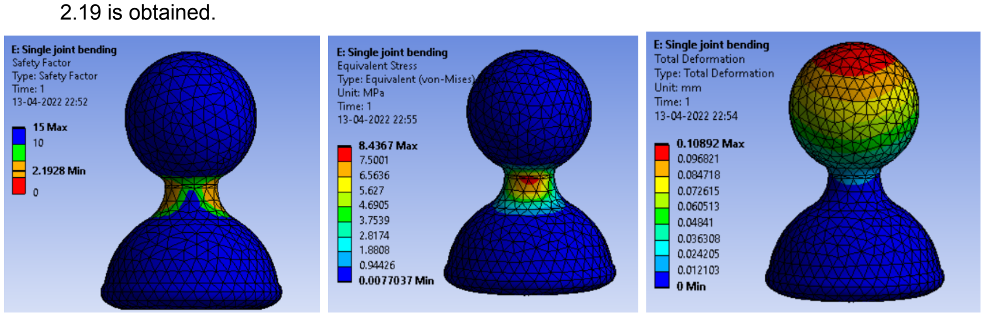
   a) **Purely tensile load**

   With the concave surface fixed and a downward force of 150N on upper surface, a minimum factor of safety of 2.46 is obtained.



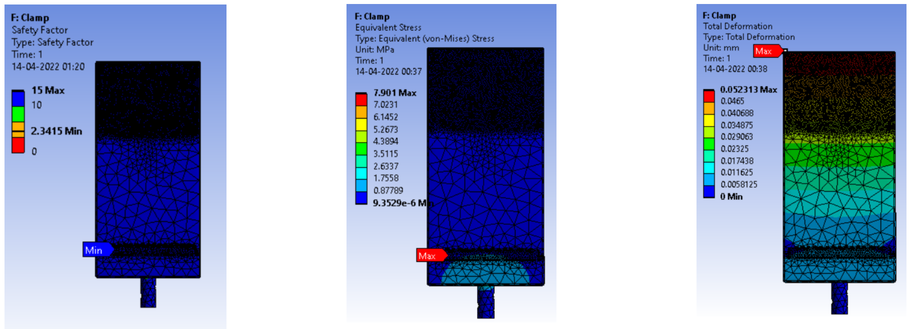
   b) **Purely bending load**

   With the concave surface fixed and a sideways force of 20N on the upper surface, a minimum factor of safety of 2.19 is obtained.



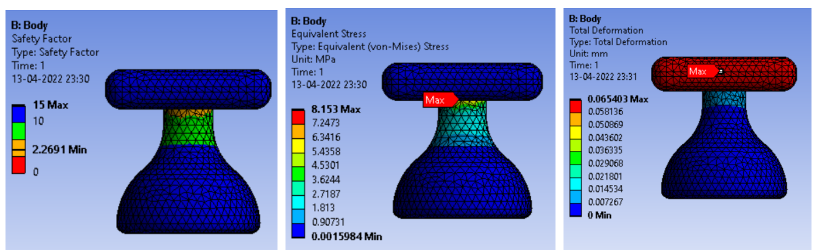
2) Clamp Base

For a force of 900N on the lower phone clamp and fixed support on the underside, a minimum factor of safety of 2.34 is obtained.



3) Body

For a downward force of 150N on the upper surface and fixed support concave one, a factor of safety 2.27 is obtained



Assessment of Design and Suggestions

Based on our analysis and customer reviews found on online shopping sites (refer to appendix), we have made the following conclusions on the design:

1) The joints are not greatly designed. There were various instances where the spherical joints were either too loose (slipping of joints) or too tight
2) The manufacturing quality needs to be improved. Though the material used (ABS) claims to be high-quality, it was reported to be of cheap quality and weak at times
3) For the tripod to be more robust, links should be made with higher precision so that they don't create gaps in between them.
4) The addition of another layer in grooves around the base link is required for better floor grip.
5) For the tripod to be more durable, a higher quality spring in the prismatic joint at the holder must be implemented.

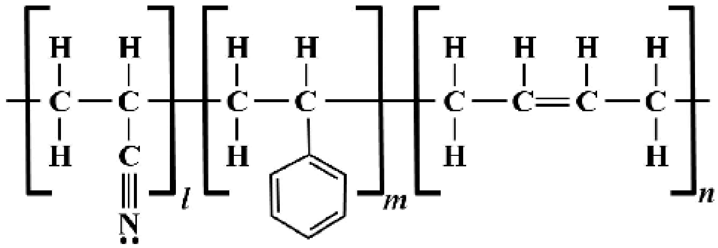
Suggestions

- Using more suitable material/finish at joint
- Improvement of manufacturing quality
- Tougher joint design
- Use of higher quality springs
- Addition of Silicon/ rubber layer/ grooves around the base link for better grip

APPENDIX

MATERIAL USED

acrylonitrile butadiene styrene **(ABS)**



- **Acrylonitrile butadiene styrene** is a copolymer with good toughness and impact strength. ABS provides favorable mechanical properties such as impact resistance, toughness, and rigidity when compared with other common polymers.
  It is light in weight and can hold a good amount of stress but fails at an extreme amount of stress.

Density = 1.0-1.05 g/cm3
Young's Modulus= 2.28 GPa
Poisson Ratio= 0.45
Yield Strength= 22.1 - 74.0 MPa

- **FAILURE MODES AND EFFECTS ANALYSIS (FMEA) OF GORILLA TRIPOD**

FMEA is a methodology designed to identify potential failure modes for a product or process, assess the risk associated with those failure modes, rank the issues in terms of importance and identify and carry out corrective actions to address the most serious concern.
A key output of FMEA is the "Risk Priority Number"
RPN = Severity x Occurrence x Detection

A few customer reviews:

1. The mobile holder was broken too soft not at all good for beginners.
2. I am using this gorilla pod for a few months, in a month itself the joints get loosened up.
3. No cushion support for the head ball of a tripod.
4. The mobile holder does not screw on tightly with the tripod head and wobbles hence making it absolutely useless for its purpose of use.
5. I wouldn't use this stand for my phone as well. It will fall even if the wind blows.
6. The handle of the tripod broke on its first usage. It came out and it won't go back in now. The legs of the tripod don't slide out easily as well, you have to pull them.
7. The item is cheap, China-made, with low-quality plastic.
8. It has shoddy plastic components which are coming off.
9. It doesn't tilt to the right or left, as the joints are extremely tight.

REFERENCES

https://dielectricmfg.com/knowledge-base/abs/

https://en.wikipedia.org/wiki/Acrylonitrile_butadiene_styrene

https://www.amazon.in/product-reviews/B08LPJZSSW/ref=acr_dpx_hist_1?ie=UTF8&filterByStar=one_star&reviewerType=all_reviews#reviews-filter-bar