BEng Mechanical Engineering

Conceptual Design of a Dual Rope Assisted Braking Belay

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The Problem

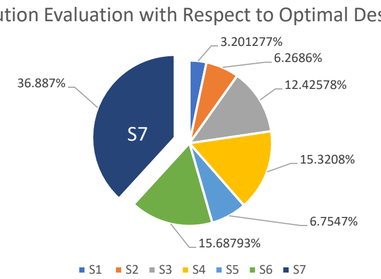
Currently there is a distinct lack of belay devices that have both assisted braking capability and compatibility with two ropes on the market.
The goal of the project is to improve the safety and versatility of climbing belays, especially for traditional climbing.

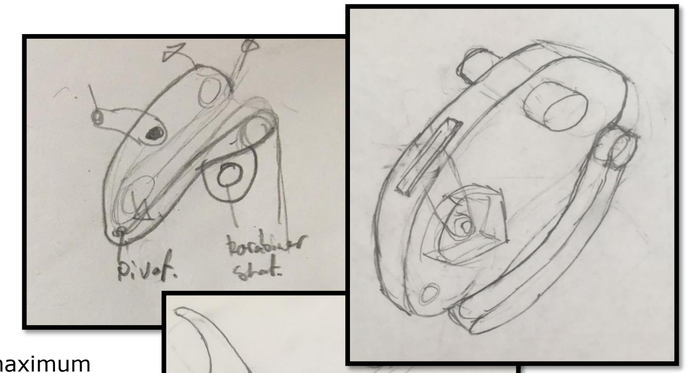
Aims And Objectives

- To produce a conceptual design for a dual rope assisted braking belay.
- To do market research of existing belays to highlight deficiencies and drawbacks of existing products.
- To conceptually design the new product/solution.
- To detail and develop new design
- To test and evaluate prototype of new design

Candidate Solutions & Options Analysis

Using the theory of innovative problem solving seven candidate solutions where produced. Using the AHP these candidate solution where evaluated and solution 7 was selected as the optimum design.

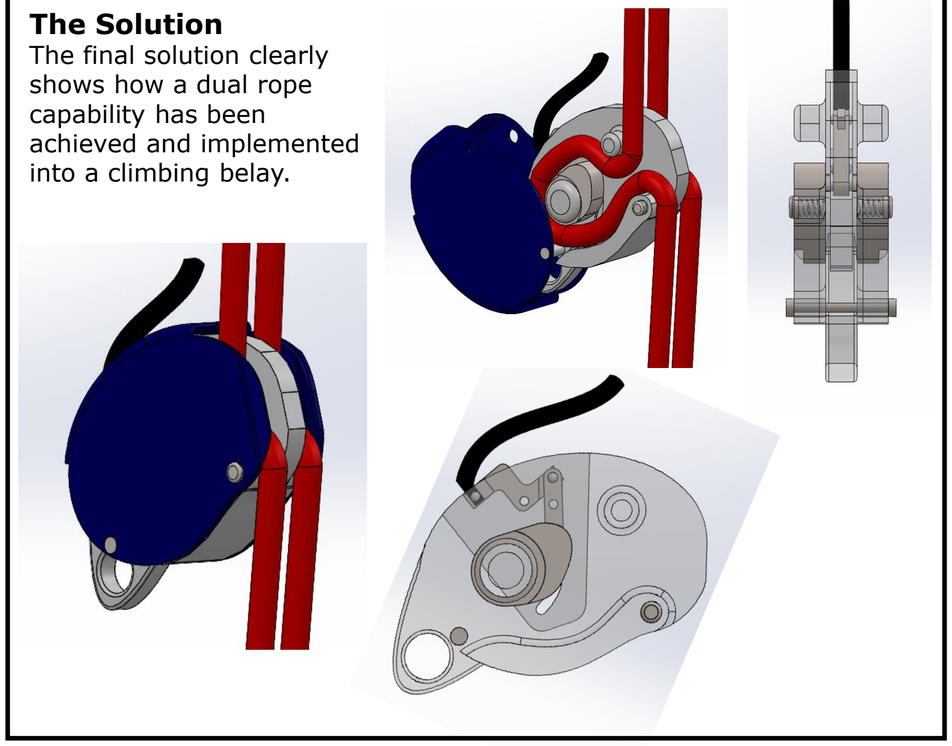




Candidate solution 7

The Solution

The final solution clearly shows how a dual rope capability has been achieved and implemented into a climbing belay.



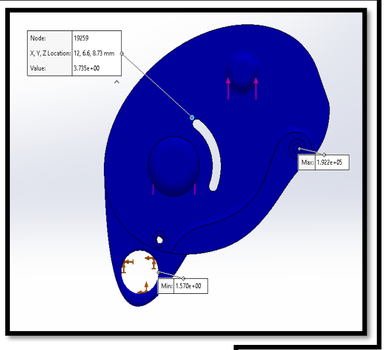
The maximum forces experienced by the device have been calculated using the belt friction formula:

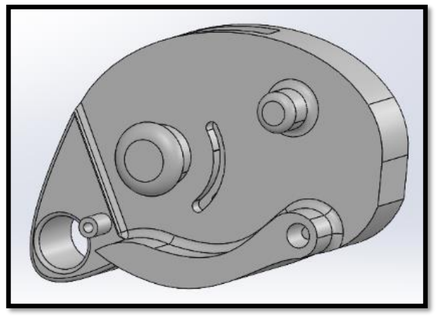
$$\frac{T_1}{T_2} = e^{\mu\theta}$$

Design Optimisation

From the results of the static analysis a SolidWorks design study was carried out with a goal of bring the FOS to a safe value of 1.5.

The main area for optimisation was the karabiner attachment hole. The thickness of the part was then increased to bring the FOS value form 1.2 to 1.5.





A fillet radius has been added to the optimised design to remove its sharp edges.

Conclusion

The project has been a success despite the challenges faced with producing an entirely conceptual design. However, these challenges allowed the extensive use of SolidWorks that built on pre-existing skills and caused a need to research and develop new skills within SolidWorks. Also, the author has developed skills in both project management and project planning. Overall, the work produced in this report is of a high standard and reflects the large amount of time and effort that has been put into it.

Design Evaluation

A static analysis of the belay body was carried out to verify the strength and safety of the design.

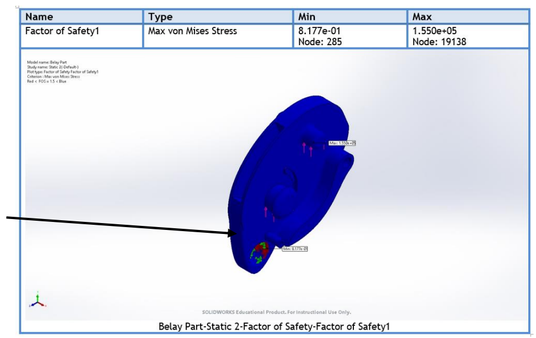
The FOS plot shows areas of the part with a FOS of less than 1.5. Areas that are red show low FOS values

Displacement plot defines the maximum displacement from the applied stress.

Stress plot showing areas of high and low stress.

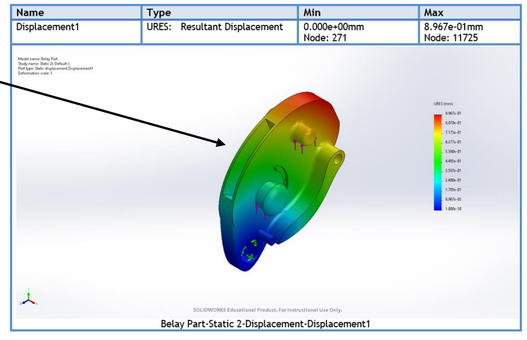
SOLIDWORKS

Name	Type	Min	Max
Factor of Safety1	Max von Mises Stress	8.177e-01 Node: 285	1.550e+05 Node: 19138



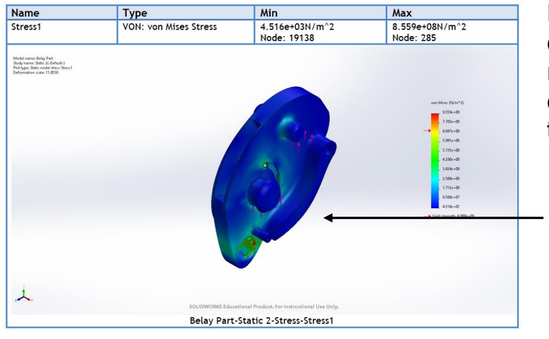
Belay Part-Static 2-Factor of Safety-Factor of Safety1

Name	Type	Min	Max
Displacement1	URES: Resultant Displacement	0.000e+00mm Node: 271	8.967e-01mm Node: 11725



Belay Part-Static 2-Displacement-Displacement1

Name	Type	Min	Max
Stress1	VON: von Mises Stress	4.516e+03N/m^2 Node: 19138	8.559e+08N/m^2 Node: 285



Belay Part-Static 2-Stress-Stress1