

CAD Engineering Analysis Report

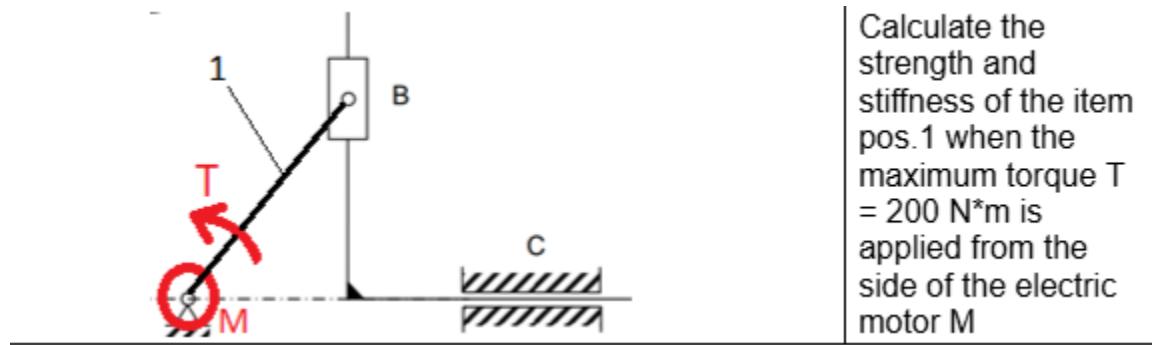
Strength and Stiffness Assessment of Item Position 1

Task: Engineering Analysis in Onshape Simulation

Objective: Evaluate the strength and stiffness of the assembly when subjected to a maximum torque of **200 N·m** applied from the electric motor **M**.

1. Introduction

This report presents the engineering analysis results for item **position 1** under the given load conditions as shown in the image below.



The study is conducted using **Onshape Cloud CAD** application, focusing on:

- Maximum stress and comparison with the material's yield strength.
 - Maximum displacement of the structure.
 - Factor of Safety (FoS) assessment.
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2. Simulation Setup

2.1 Model Assumptions and Boundary Conditions

- **Material:**
 - Hardened Alloy Steel
 - Density (Kg/mm^3) – $7.850\text{e-}6$
 - Poisson ratio – 0.285
 - Tensile Yield Strength – 415MPa

Material	
Library	Custom
Onshape Material Library	<input type="button" value="+"/>
Hardened Alloy Steel	<input type="button" value="+"/>
Name	Hardened Alloy Steel
Density (kg/mm ³)	7.850e-6
Poisson's ratio	0.285
Young's modulus (Pa)	20000000000000
Tensile yield strength (Pa)	415000000
Ultimate tensile strength (Pa)	655000000
Compressive yield strength (Pa)	0
Ultimate compressive strength (Pa)	0

Bill of materials

Item	Material	Name
1	Carbon Steel	Pivot_head
2	Carbon Steel	Block_Horizontal
3	Carbon Steel	Link_vertical
4	Hardened Alloy Steel	Swing_link
5	Carbon Steel	Box_weight
6	Carbon Steel	Bolt_2
7	Carbon Steel	Bolt_1

- **Fixed Supports:** Base M and C were fixed. While B is a sliding mate connected box weight.
- **Load Application:** Torque $T = 200 \text{ N}\cdot\text{m}$ (1905N) applied at M

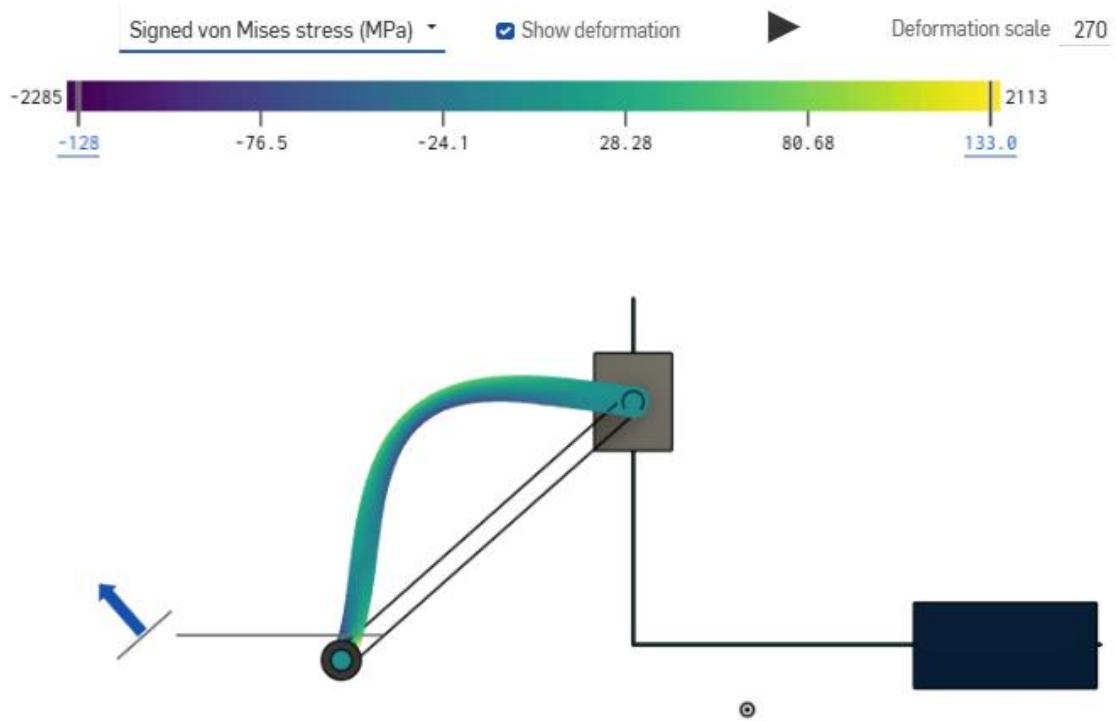
2.2 Simulation Methodology

- Static stress analysis was performed.
- The component is evaluated for maximum stress and deformation.
- Factor of safety is calculated based on yield strength.

3. Results and Analysis

3.1 Maximum Stress

- **Result:** 133MPa
- **Comparison with Yield Strength:** $\sigma_{\max} = 133 \text{ MPa} \leq 415 \text{ MPa} = \sigma_{\text{yield}}$
- **Interpretation:** It can be confirmed that the stress was within the limit.

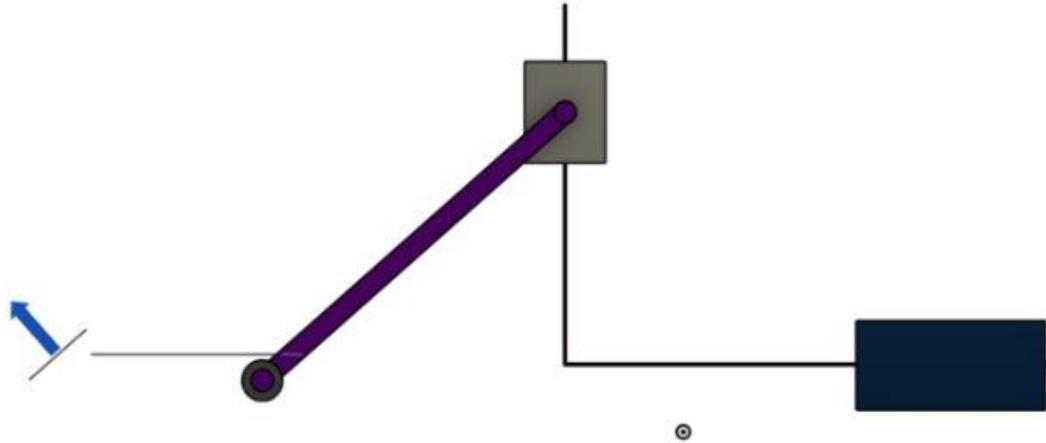
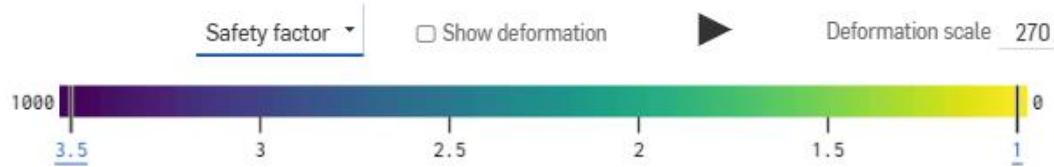


3.2 Maximum Displacement

- **Result:** .126 mm
- **Location:** Pivot region attached to box weight

3.3 Factor of Safety (FoS)

- **Calculation:** $\text{FoS} = \text{Yield Strength}/\text{Max Stress} = 415/133$
- **Result:** 3.1
- **Assessment:** The structure is safe as $\text{FoS} \geq 1$.



4. Conclusion and Recommendations

- The maximum stress in the structure is **133 MPa**, which **is** within the material's yield strength.
- The maximum displacement recorded is **.126 mm**, which **is** acceptable for structural stability.
- The **Factor of Safety = 3.1**, indicating that the structure **is** safe under the applied torque.

Appendix A – Simulation visual of the structure on Onshape

