FEM Project NO.1

Huang Yuchong

Finite Element Method Project No.1

April 15, 2024

Section A

1. Puepose and Scope

The objective of the project is to use ABAQUS to analyze an existing bicycle frame subjected to two loading conditions. The material is 6061T6 Aluminum Alloy with Young's modulus 68.9 GPa and Poisson's ratio 0.3. For simplicity, a 2D model with beam element is devedoped to find the maximum tensile stress and the location where the maximum occurs. What's more, I will give a design to reduce the maximum tensile.

2. Results and Discusstion

With the simulation by ABAQUS, we can get the result that the maximum tensile stress of **case 1** is 1.610Mpa, and 0.7394Mpa for **case 2**. Both of them occurs at the corner point.

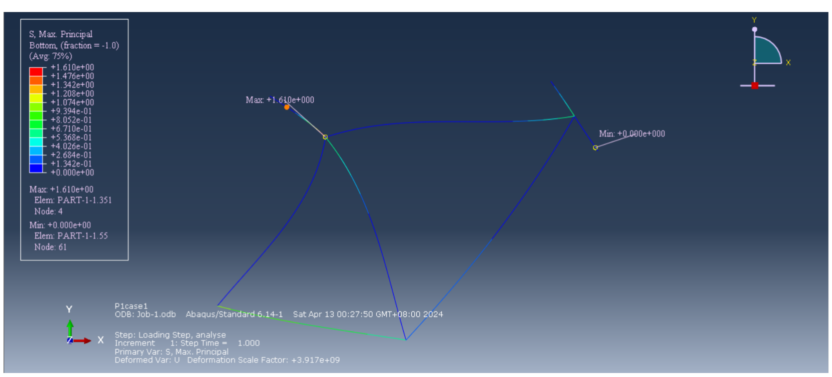

Figure 1: Result of case 1

As for optimilization, it is easy to just thicken the pipe wall, but I want to make it without adding material, so I design a similar but new structure.

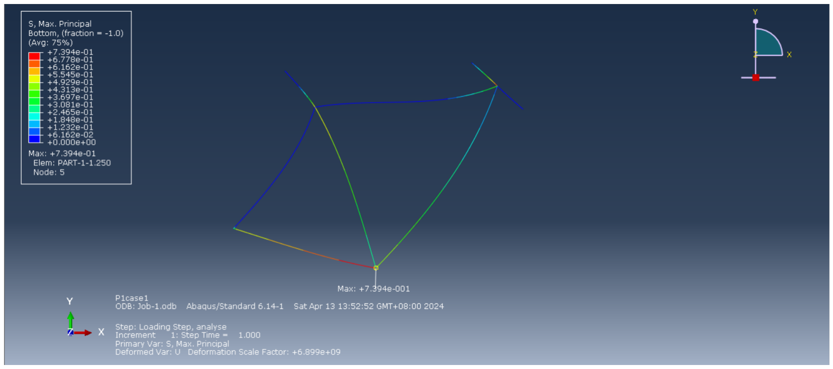

Figure 2: Result of case 2

And in fact, **case 1** and **case 2** represent the situation that a person sitting quietly on the bicycle and pedaling respectively. So the optimism needs to work for both situations.

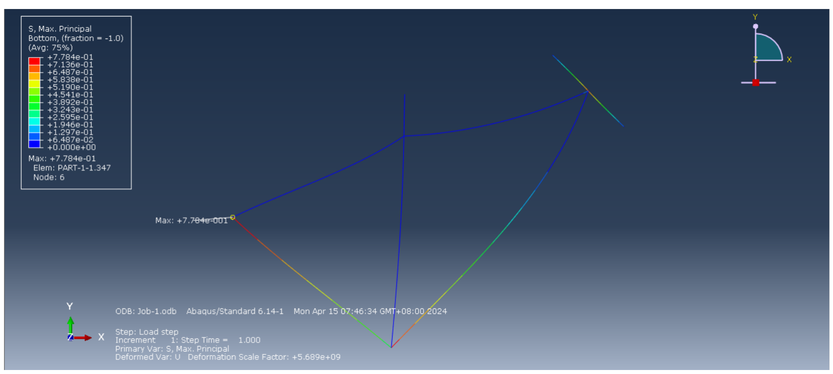

Figure 3: Result of optimism for case 1

As a result, the maximum tensile stress of **case 1** is 0.7704Mpa, and 0.6637Mpa for **case 2**. Both of them occurs at the corner point. Two cases reduce 72.3% and 10.2% tensile stress. Whatever, it can show that this structure is better than origin structure if take tensile stress as the criterion.

3. Conclusions and Recommandations

In this project, I analyze an existing bicycle frame in two loading condition by ABUQUS. As a result, I find the maximum tensile stress and the location where the maximum stress occurs. What's more, I give a design to reduce the maximum stress without adding materials.

However, the optimism doesn'y performs very good in **case 2**. Maybe I could try to thicken the pipe wall to pursue better performance in reducing

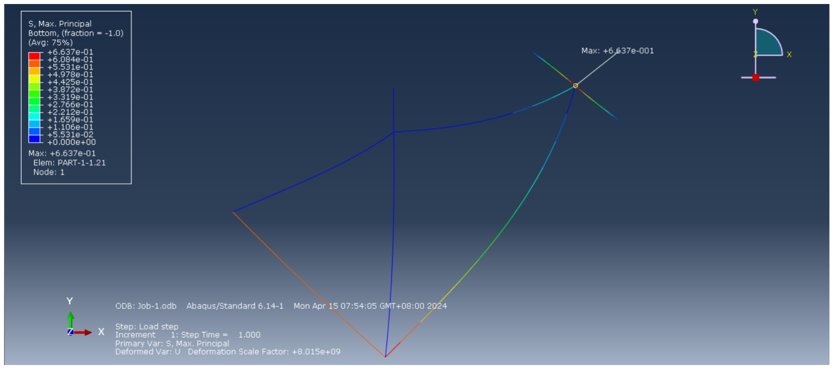

Figure 4: Result of optimism for case 2

tensile stress.

Section B

Appendices

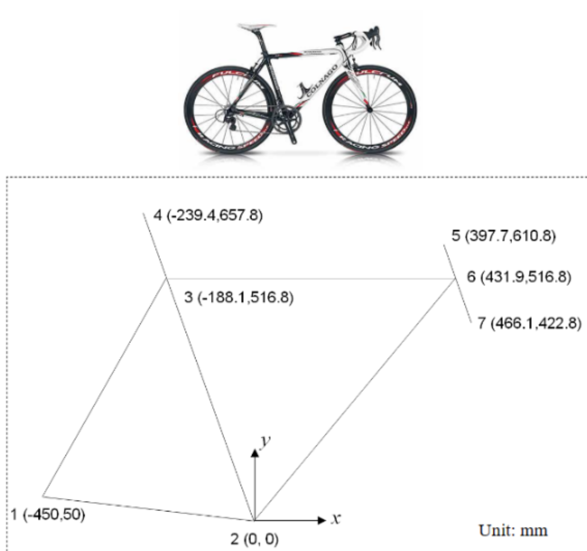

Figure 5: Schematic diagram of the bicycle frame

Bar	Outer Diameter (mm)	Wall Thickness (mm)
1-2	30	3
1-3	30	3
2-3	35	3.5
Others	42	3.5

Figure 6: The specified cross-sectional profiles

Load Case 1:

- Displacement Constraints:
  - Point 1: $u_x = 0$ $u_y = 0$
  - Point 6 : $u_y = 0$
- Applied Forces:
  - Point 4: $F_y = -900$ N
  - Point 5: $F_x = -120$ N
  - Point 7: $F_x = 120$ N

Load Case 2:

- Displacement Constraints:
  - Point 1: $u_x = 0$ $u_y = 0$
  - Point 6 : $u_y = 0$
- Applied Forces:
  - Point 2: $F_y = -600$ N
  - Point 4: $F_y = -300$ N
  - Point 5: $F_x = -120$ N
  - Point 7: $F_x = 120$ N

Figure 7: Two loading cases

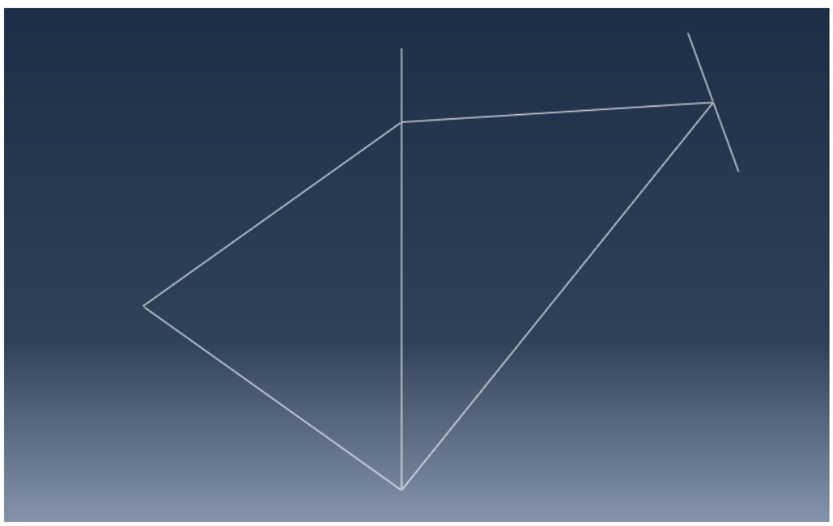

Figure 8: The figure of optimism