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Structural improvement based on CATIA and ABAQUS

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Abstract: *China is a big trading country with a large number of ports, so a large number of loading and unloading vehicles are needed to carry out cargo transportation. As a traditional lifting model, the front loading and unloading vehicle plays a vital role in the port cargo lifting. The traditional front crane boom has many problems, such as unreasonable stress structure, low service life, easy fatigue and wear. CATIA and ABAQUS are used to model and simulate the boom, and realize the lightweight, stabilization and firm arm by adding triangular ribs, structural ribs and reasonable hollow out of the axial section.*

Keywords: *boom, modeling and simulation, lightweight, stable, firm*

1. Introduction

Front crane loading and unloading truck plays an important role in China's logistics and transportation industry. It has many advantages and plays a positive role in the development of China's logistics industry. This equipment can quickly grab and move containers, greatly reducing the time and manpower required by traditional manual loading and unloading, thus improving the loading and unloading efficiency and speeding up the logistics speed. At the same time, it can adapt to different sizes and types of containers, as well as a variety of different loading and unloading environments. This enables it to complete the loading and unloading tasks under various complex conditions, and improves the reliability and stability of loading and unloading as shown in Fig 1. In addition, the front crane loading and unloading truck can also effectively reduce the cost. Due to its high efficiency and reliability, the use of frontal cranes can reduce the waste of manpower and time, thus reducing logistics costs. At the same time, it can also reduce the damage rate of goods, further reducing the transportation costs. To sum up, the frontal lifting and loading and unloading truck plays an important role in China's logistics and transportation industry. In the future, with the continuous development of the logistics industry, the importance of front crane loading truck will be further enhanced.

Figure 1: Front crane loading truck

As the main bearing part of the crane, the boom is responsible for lifting and moving the container. Due to the particularity and diversity of the operating environment of the automobile crane, it is required to have a good work Good interference resistance, low deformation, and low stress levels.[1]

At present, the boom of the front crane has the following problems:

Structural problems: in order to reduce the instability in the process of lifting arm, resulting in its

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heavy structure, high energy consumption rate and insufficient lightweight.

Fatigue problem: because the boom needs to frequently bear the weight of the container and the impact force during lifting, it is easy to produce fatigue cracks. The fatigue crack may gradually expand and eventually breaking the boom.

Vibration problem: During lifting and moving the container, the boom may produce vibration, affecting its stability and service life. Especially when the lifting height is high or heavy, the vibration problem is more obvious.

2. Text part

2.1. Research status, both at home and abroad

In China, with the rapid development of the logistics industry, the application of the frontal crane is more and more extensive, and the research on the crane arm is also increasingly attracting attention. Some domestic universities and scientific research institutions have studied the structural design, material selection, manufacturing technology and other aspects of the boom, and have achieved certain results. For example, some research institutions have carried out experiments and analysis on the fatigue performance of the boom to explore its fatigue life and influencing factors, which provides theoretical support for improving the durability and safety of the boom. In addition, some domestic enterprises have also improved their independent research and development and innovation ability of the hanging arm, gradually narrowing the gap with the international advanced level.

In foreign countries, the boom research of frontal crane has been relatively mature, and many international well-known enterprises have invested a lot of resources in relevant research and development. For example, Kalmar in Sweden and Lind in Germany have their own research and development teams and experimental facilities to conduct comprehensive research on the materials, structure and manufacturing process of the boom arm. By adopting advanced materials and processes, these enterprises optimize the structural design and improve the performance and safety of the boom to meet the market demand.

In general, some progress has been made in the research of frontal cranes at home and abroad, but there are still some challenges and problems. Therefore, it is still necessary to further strengthen the relevant research in the future to promote the continuous progress and development of the boom technology of the front crane.

2.2. Research results

By multi-directional data investigation, the positive crane in the corner of 0 and 70 position roughly in the limit working point, according to the normal small loading vehicle grab 5t-20t cargo weight range, in the grab work point apply 40000Pa pressure, and on the basis of ABAQUS simulation, HG 70 profiles was used with Young's modulus 206 GPa, Poisson's ratio 0.31 and density $7.85\times10^{3}kg.m^{-3}$.[2]simulation cloud diagram, which is more bright color, shows that the greater the stress.The results obtained in ABAQUS are shown in Fig 2, Fig 3 and Fig 4.

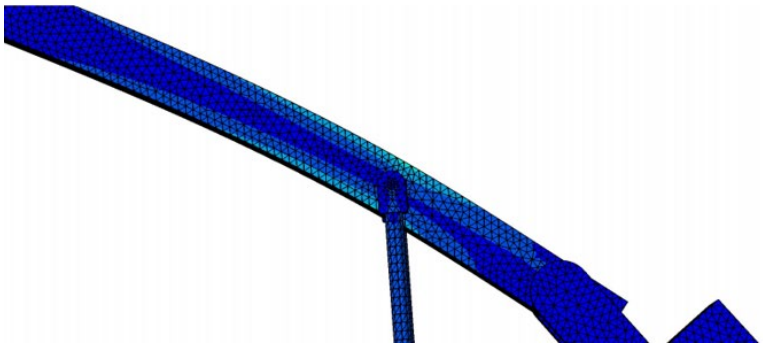

Figure 2: 70 Angle position View of force force of the arm

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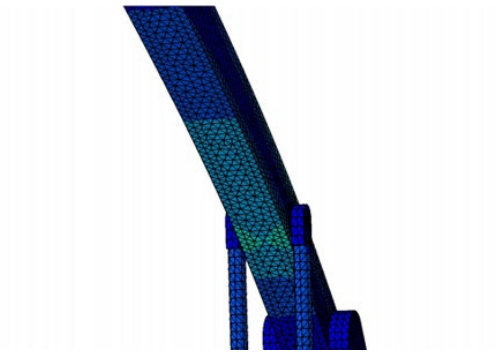

Figure 3: 70 Angle position Force view of force of of at the position

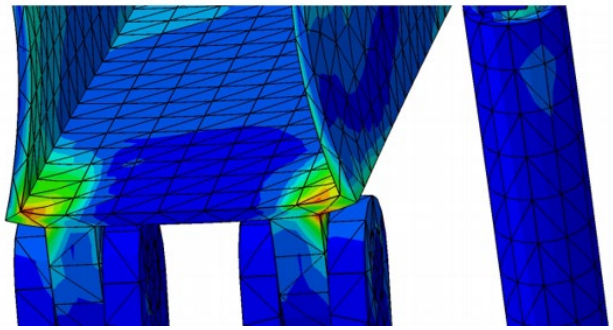

Figure 4: 0 Angle position at the connection of arm and base

From the simulation cloud diagram, we can see that the structural stress in the middle position of the boom and the position of the hanging ear is large, which is a dangerous working point, and the design needs to be optimized. [3]

2.3. Improvement

Using CATIA to model the boom as required, we can obtain the new boom model as shown in Fig 5.

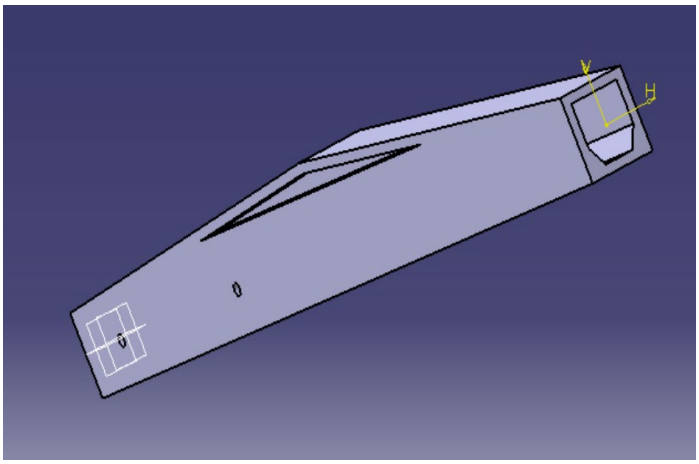

Figure 5: New cantilever structure

Over the traditional boom, the interior of the boom is hollow to realize lightweight structure and the section adopts pentagonal design to reduce the stress at the connection between the boom and the base. This simulation cloud diagram is shown in Fig 6 [4]:

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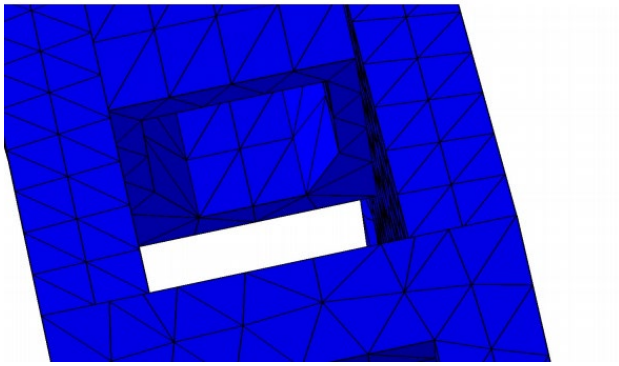

Figure 6: Force cloud map at the connection between boom and base

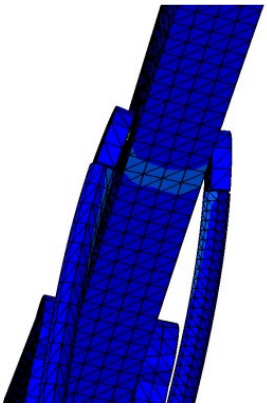

Figure 7: The abdominal force cloud diagram of the hanging arm

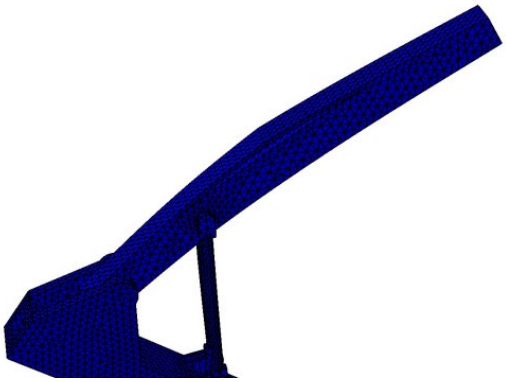

Figure 8: Force force of new crane

As can be seen from the structural cloud diagram in Fig 7 and Fig 8, the excessive stress of the boom structure is significantly improved, indicating that this treatment method is effective and feasible. [5]

3. Conclusion

Through the optimization design of the traditional boom, the lightweight, stabilization and firm improvement of the boom is realized, which has practical significance for supporting the reform and innovation of China's loading and unloading vehicle industry.

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