The Application of the Design of Mobile Belt Conveyor Special-shaped Frame Structure Based on Solid Works Finite Element Method

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Abstract. This paper briefly discusses the application of the design of mobile belt conveyor special-shaped frame structure based on solid works finite element method. Take the special-shaped of the mobile belt conveyor as an example, using Solid Works analysis software for modeling and stress analysis. Through the stress analysis of special-shaped frame of mobile belt conveyor, this paper gets the vulnerabilities of the special-shaped frame structure, and optimizes these defects to improve the design of structure and enhance the design efficiency.

Introduction

With the development of various kinds of three-dimensional software and improvement of related disciplines, people have changed the old traditional method, which just depending on the static strength theory to design structure. The stress magnitude and distribution of mechanical parts and components have the relationship with the distribution of carrying charges, and also have the relationship with the size, shape and material of components. Through the stress analysis of special-shaped frame of mobile belt conveyor, this paper gets the vulnerabilities of the special-shaped frame structure, and optimizes these defects to improve the design of structure and enhance the design efficiency.

Solid Works Finite Element Analysis Method

Finite element analysis is the method which using simple questions instead of the complicated ones to solve problems. It takes solution domain as many little interconnected sub-domains; assuming an approximate (simpler) solution for each unit and deducing the general satisfy conditions (such as structural balance conditions) of the whole domain, then getting the solution.

Using shift equation of the finite element analysis method based on Solid Works COSMOSWorks, calculate the shift, strain and stress under the inner and outer load. Getting the value and the transformation figure of the stress. Determine the weakness of the frame structure and optimize them, lead the special-shaped structure to reach the best optimism design.

The Applications the Finite Element Analysis

This paper takes the special-shaped of the mobile belt conveyor as an example, using Solid Works analysis software for modeling and stress analysis. And then, get the value and the transformation figure of the stress.

Fig.1 Mobile Belt Conveyor

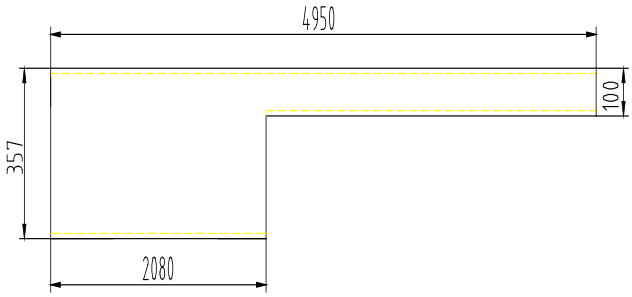

Fig. 2 Diagram of Special-shaped Frame Structure before optimizing

Mobile belt conveyor is the key equipment of the crude tobacco automatic unloading system, which is used to delivering tobacco packages in a fast way, and helping automatic tobacco automatic machine to put the tobacco package in the empty basket in a sequence of layers' order. The structure is shown in Fig.1.

Set up special-shaped frame structure model

According to the scheme of mobile belt conveyor, the thickness of the special-shaped frame structure is 6 mm; its structure diagram is shown in Fig. 2. Establishing the special-shaped frame structure model (the model can be set up in Solid Works 3D software) as shown in Fig.3. In the process of the model establishing, some simplify steps should be done to reduce the scale of the model, such as delete the small angle of chamfers, delete round holes, and extract middle plane of the thin plate.

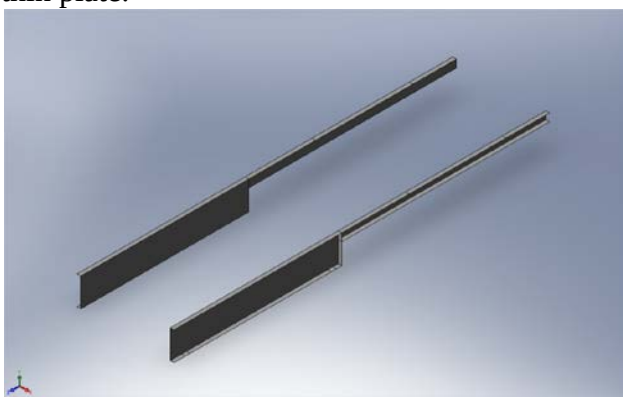

Fig. 3 The 3D model of special-shaped frame structure

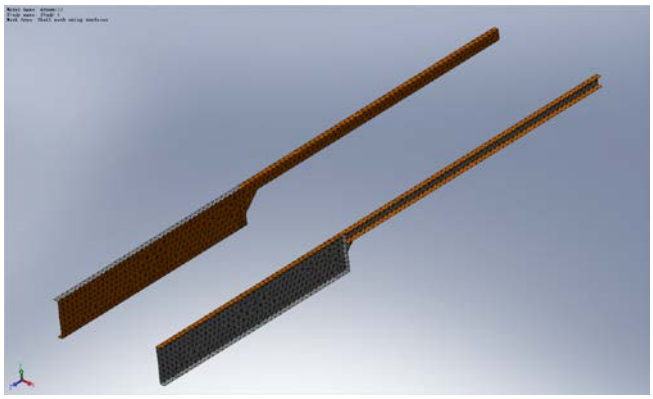

Fig. 4 The finite element model of special-shaped frame structure

Preprocessing

Using COSMOSWorks software to do preprocess for the model, see Fig. 4, which including local preprocessing, finite element grid division, material property definition, boundary constrain, load condition and ect.

Using COSMOSWorks to analysis the model and extract results

When the material at the end of the machine, which is a limit case, using COSMOSWorks software to analysis the change of the bend. As shown in Fig. 5 and Fig. 6. The changes of the stress are shown in Fig. 7 and Fig. 8.

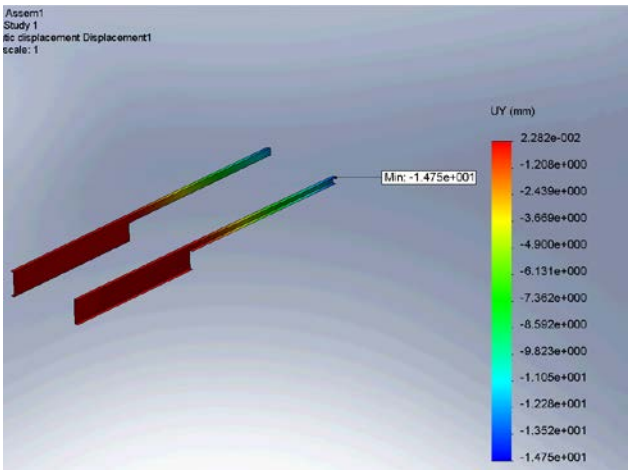

Fig. 5 The analysis of the bend degree before structure optimizing

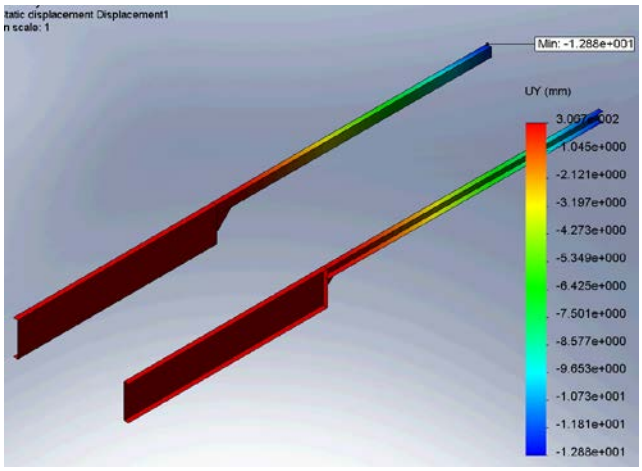

Fig. 6 The analysis of the bend degree after structure optimizing

By comparing the above analysis results, we get: the bend degree of Y direction is 14.7 mm before optimizing; and 12.8 mm after optimizing. From the bend degree, we know that when the material is at the terminal position, the change of structure bend degree is smaller after optimizing, which can meet the requirement.

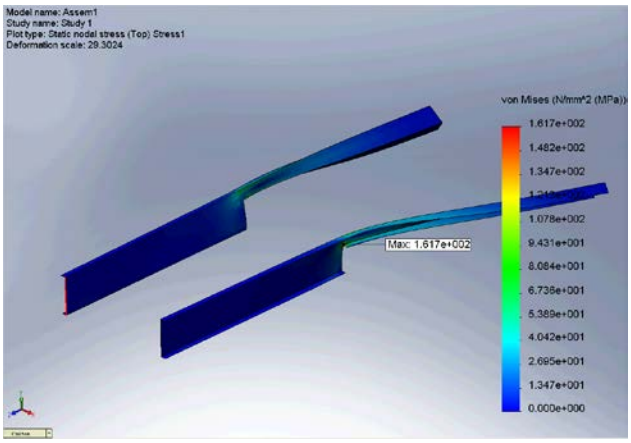

Fig. 7 Analysis of the stress before structure optimizing

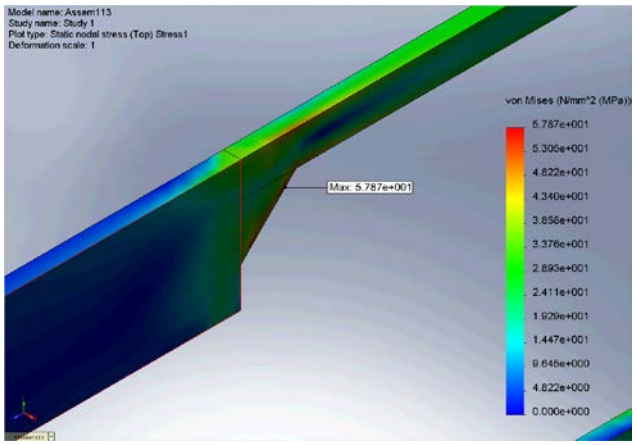

Fig. 8 Analysis of the stress after structure optimizing

By comparing the results of Fig.7 and Fig.8, we get: the stress is 161.7 bmp before optimizing; and the stress is 57.8 bmp after optimizing. Form the stress figure, we can see that when the material is at the terminal position, the tress of the frame's weakest part is 0.3 times compared with the one before structure optimizing, which can meet the requirement.

The Advantages of Finite Element Analysis Method

- The method of frame structure modeling, based on Solid Works, is more convenient and easy to adjust;
- Compared with establish real model, the method of frame structure modeling avoids the complicated assemble steps;
- Frame structure using crossbeam grid finite element analysis method, which can avoid data distortion due to the unequal division of the real model.

Conclusion

Using the finite element COSMOSWorks software to analysis frame structure's stress of the mobile belt conveyor, and compare the results with the calculated ones, and determine the right finite element model. According to the analysis results, propose the improved scheme and doing further calculation. Take all facts into consideration, at last, we decide to add two triangle boards at the weak parts of the frame structure. The finial scheme is shown in Fig. 9.

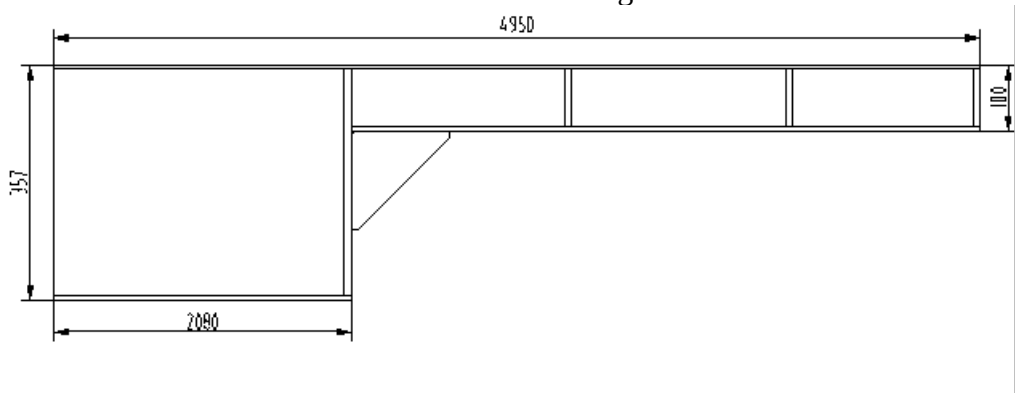

Fig. 9 The frame structure (after structure optimizing)

From current running situation, the mobile belt convey running in a very good condition. After optimizing, the frame structure is stable, meet customers' requirements and accept by customers.

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