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Structural Analysis of a Charcoal Sieving Machine Under Dynamic Load

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Abstract:For the coal classification charcoal sieving machine is used for the coal classification in the mining technology. Deflection and stress vibrating screen machine structural analysis is thus a key part of the engineering design of screen machine structures. In this paper, analysis of vibrating screen machine structural for stress and deflection. We used finite element method (FEM) to analyze stress and deflection of vibrating screen machine under dynamic load. The method provide the necessary basis for the improvement design and research on vibrating screen machine structures.

Keywords: Analysis, structure, deflection, dynamic load

I. General introduction

Vibrating screen machine is the practice of taking granulated ore material and separating it into multiple grades by particle size. This practice occurs in a variety of industries such as mining and mineral processing, agriculture, pharmaceutical, food, plastics, and recycling. Particle size distribution of hard coals ground were determined using mechanical sieving and and then selecting coals for particular processes and equipment.Coal can be simply classified by applications into two categories: thermal coal used to provide heat energy in combustion, and metallurgical coal which is converted to coke, in a carbonization process, and used mainly in the iron and steel industry. For the coal classification charcoal sieving machine is used for the coal classification in the mining technology.

Vibrating screen machine is an important component of the coal classification. The charcoal sieving machine uses the eccentric shaft vibration-exciter and the eccentric blocks to adjust the amplitude. It is applied to classified coal in the mining technology.

II. Analysis of vibrating screen machine structure for stress and deflection

2.1. Caculation model

The whole structure of the vibrating screen machine structure (700ton) is shown in Fig.1. A vibrating screen machine structure consists of a drive that induces vibration, a screen media that causes particle separation, and a deck which holds the screen media and the drive and is the mode of transport for the vibration.

Where:

1. Motor vibrator
2. Vibration of Structures
3. Outer body
4,5. Vibratory Screens Filters 1&2
6. Suspention springs
7. Fixed bracket
8. Electric motor bracket

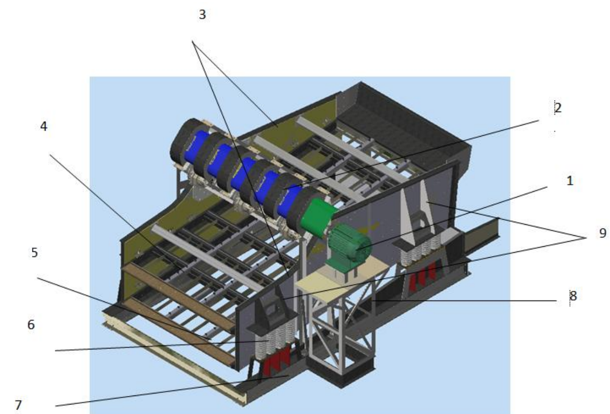

Fig.1 Model of vibrating screen machine

2.2. Principle of operation

Vibrating screen machine is a shaker or a series of shakers as to where the drive causes the whole structure to move. The structure extends to a maximum throw or length and then contracts to a base state. A pattern of springs are situated below the structure to where there is vibration and shock absorption as the structure returns to the base state.

The main screening assembly is suspended on rugged springs that allow it to vibrate freely while minimizing power consumption and preventing vibration transmission to the floor. The assembly is equipped with one imbalanced-weight gyratory motor that creates multi-plane inertial vibration for the purpose of controlling the flow path of material on screen surfaces, and maximizing the rate at which material passes through the screen.

Material is fed onto the center of the screen, causing particles larger thanscreen apertures to travel across the screen surface in controlled pathways, and exit through a discharge spout located at the screen's periphery, while particles smaller than screen apertures pass through the screen onto a lower screen or exit through a lower discharge spout.

2.3. Load and boundary conditions

Analyzing load characteristic is shown in Fig.2

Centrifugal force $F_n = F_{n1} + F_{n2}$

Where:

- Vertical components of force: $F_{n1} = P_n.\sin\alpha$
- Horizontal components of force: $F_{n2} = P_n.\cos\alpha$

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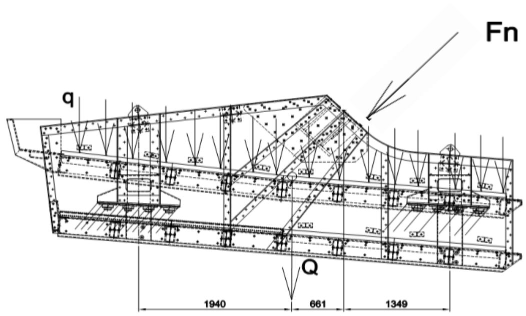

Fig.2. Loads acting on the vibrating screen machine structure

- Centrifugal force:

$$F_n = 12.m.r.\left(\frac{\pi.n}{30}\right)^2$$

Where:
- Weigh of vibrator part: m = 67,3 kg
- Disk of radius: r=94mm
- Rotational speed n=980 (rpm)

$$F_n = 798717.3 \text{ kN}$$

- Load distribution:

$$q = \frac{m}{S}.g$$

- Weight of coal/s.

$$m = \frac{700000}{3600} = 194.44\text{kg}$$

- Screen area:

$$S = 17.04\text{m}^2$$

- Acceleration due to gravity

$$g = 9.81\text{m/s}^2$$

2.4. Finite element model

The main structure adopted solid element SOLID95 and SOLID92. The spring used COMBINE14 and the vibration generator was simplified as lumped mass element MASS21. The finite element model was setted in Inventer.

2.4. Deflection and stress vibrating screen machine structural

Stress ofvibrating screen machine structural are as shown below.

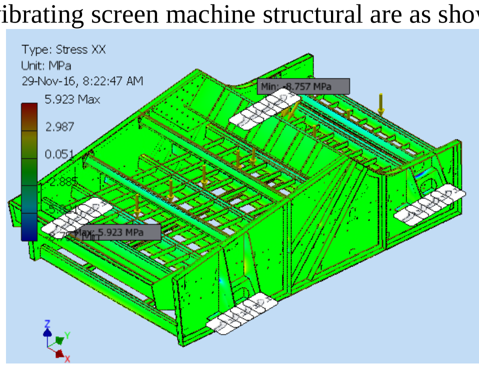

Fig.3. The maximum stress in the structure (σ_x)

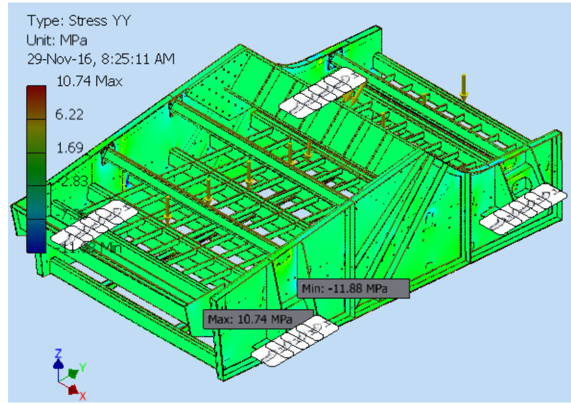

Fig.4. The maximum stress in the structure (σ_y)

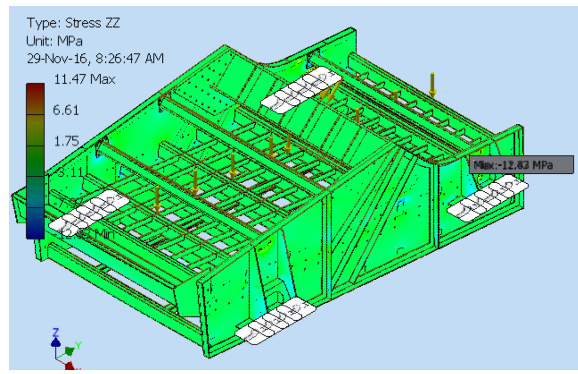

Fig.5. The maximum stress in the structure (σ_z)

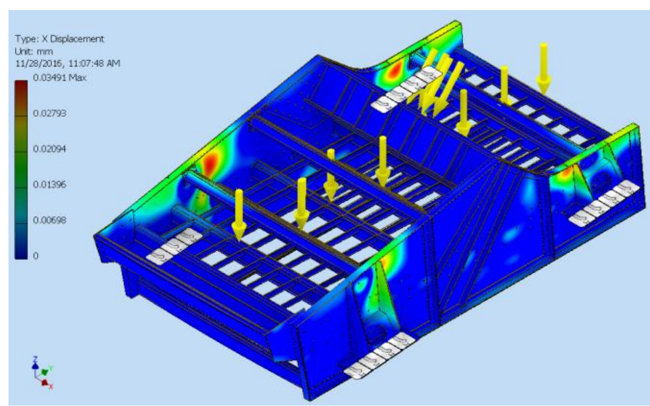

Fig 6. Stress field models of structural

From computation results of stress vibrating screen machine structural:

+ σ_x^{max} = 5.923 Mpa
+ σ_x^{min} = -8,757 Mpa
+ σ_y^{max} = 10.74 Mpa
+ σ_y^{min} = -11.88 Mpa
+ σ_z^{max} = 11.47 Mpa
+ σ_z^{min} = -12.82Mpa

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Displacement of vibrating screen machine structural are as shown below.

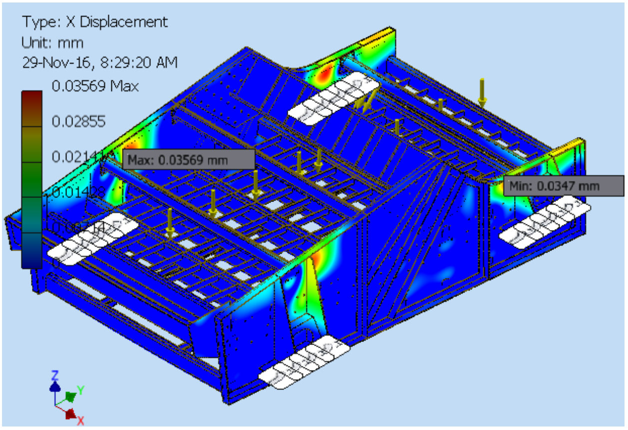

Fig.7. The maximum displacement in the structure (x-x)

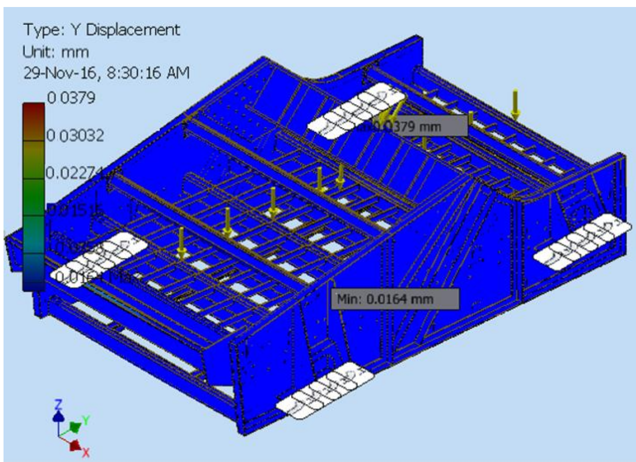

Fig.8. The maximum displacement in the structure (y-y)

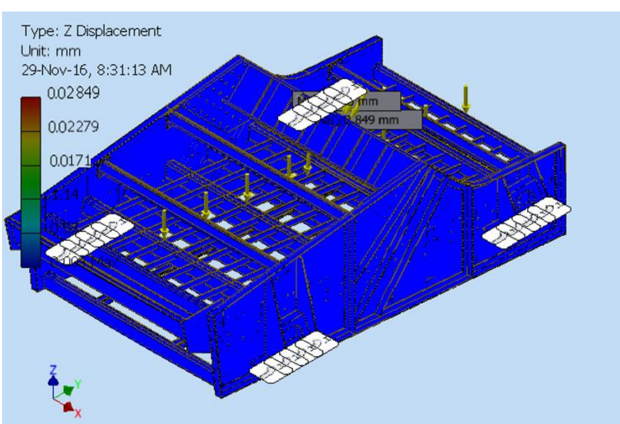

Fig.9. The maximum displacement in the structure (z-z)

From computation results of displacement in vibrating screen machine structural:

- x-x direction:

$+x_{max} = 0.03569$mm

$+x_{min} = 0.0347$mm

- y - y direction:

$+y_{max} = 0.0379$mm

$+y_{min} = 0.0164$mm

- z - z direction:

$+z^{max} = 0.02849$ mm

$+z^{min} = 0.003$mm

III. Conclusion

This paper studies finite element method for ultimate strength analysis of vibrating screen machine structure underdynamic load. The finite element method is an important method and necessary process in the dynamic design process of vibrating screen. Using FEM to analyze structural characteristic can help the designers realize dynamic characteristic of vibrating screen and make dynamic modification of the structure.

In this paper, displacement and stress vibrating screen machine structural analysis is calculated by FEA program. It aims to explore the influence on the ultimate strength which is made by dynamic load, after accounting the nonlinear finite element of the vibrating screen machine structural model. Finally to put up with a set of complete accumulation method, laying a foundation for accounting the ultimate strength of vibrating screen machine structural

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