International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 05 Issue: 01 | Jan-2018 www.irjet.net p-ISSN: 2395-0072

A Review -Vibrating Screen and Vibrating Box: Modal and Harmonic Analysis.

Vishal Shrimandhar Masutage[1], Mukund V. Kavade[2]

[1]Student, Dept. of Mechanical Engineering, Rajarambapu Institute of Technology,Islampur, Sangli, Maharashtra, India.
[2] Associate Professor, Dept. of Mechanical Engineering, Rajarambapu Institute of Technology, Islampur, Sangli, Maharashtra, India.

Abstract - *Modal analysis and harmonic analysis have been carried out based on dynamic analysis technology. Two different models of vibrating screen and vibrating box have considered for the analysis. The working frequency selection of the vibrating screen was studied using ANSYS. A simplified model of vibrating box and vibrating screen was constructed by using SolidWorks, and then imported into the Simulation to analysis its modal and harmonic characteristics. The stress distribution, deformation and structural natural frequency, mode shapes under static loads of the self-balance vibrating screen were calculated to provide theoretical basis for the following analysis of the dynamic characteristics and structure optimization design of vibrating screen to ensure the screen and box has sufficient strength and longevity.*

***Key Words*: Working Frequency, Modal and Harmonic Characteristics, Natural Frequency, Mode Shapes**

1. INTRODUCTION

The vibrating screen is a common screening machine for industrial and mining enterprises. It is made up of vibrator, a screen box, a damping device and Transmission device. The exciting force is generated by the vibrator when the vibrating screen works. The shaker box may break in the long-term work; especially the sides of the screen box may fracture. This paper adopted a knockout machine as the object to study and analyze the stress distribution and deformation under static loads, check the strength of shaker box and analyze whether it will resonate by calculating the natural frequencies and mode shapes of the structure. The vibrating screen do forced vibration when it is under high-intensity loads. It is prone to fatigue failure. The key components of the vibrating screen are screen box, because of its complex structure and shape; the traditional design methods cannot calculate its stress.

1.1 Construction of the finite element model

There are some differences between three-dimensional and finite element model. In order to reduce the number of cells and improve the efficiency of the operation, simplification based on the three-dimensional model can be made as follows: because the vibrating screen is Symmetrical in structure, the force and installation form are also symmetrical, so half of the model can be used to analyze; bolts and other standard connectors can be removed; regard the welding assemblies as a whole by removing welds; the bolt holes, fillets and other details that have little effect on the analysis should be ignored; remove the discharge port, feed inlet and the supporting device, define the spring like "connector".

The screen box is divided into two parts: screen and screen frame. Screen is installed in the interior of screen frame, as shown in Fig1. The screen box is located in the vibration damper using springs. Material enters into the upper ports of screen box and is discharged through the bottom ports in the working.

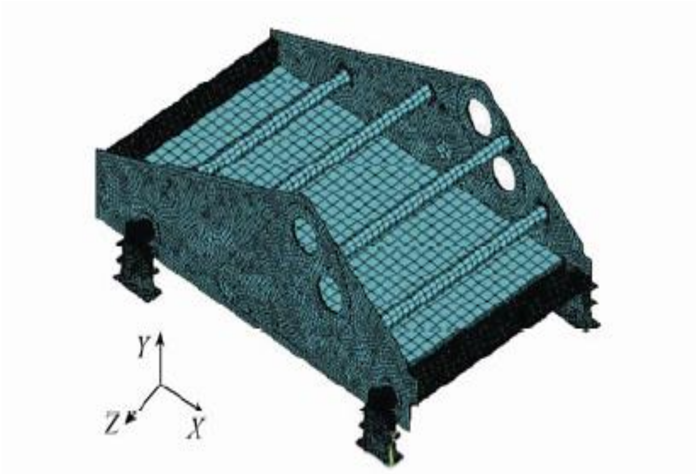

Fig 1.1 finite element model

2. Model analysis

The aim of modal analysis is to determine the natural frequencies and formations of the vibration screen box, to know the vibration characteristics of vibrating screen that can offer references to screen designation or structure modification and to pave the way for dynamic response analysis for the vibrating screen. Block Lanczos method is applied for modal analysis. Modal calculation is to extract the natural frequency of the screen box and the corresponding vibration modes. It can avoid the probable resonance in the design of the vibrating screen. Since the natural frequency of the screen box and the corresponding vibration modes are extracted through the structural free vibration equation which has no external force, so the exciting force and inertial acceleration of the model should be removed before the modal analysis.

Table -1: Modal frequency

Order	Frequency (Hz)	Order	Frequency (Hz)
1	1.4671	7	9.0478
2	1.5095	8	11.3510
3	3.4330	9	13.2510
4	5.0240	10	19.1230
5	6.2672	11	19.8800
6	6.3041	12	20.9630

The first ten mode shapes are shown in Fig 2.1. The first-order mode shape is the rigid motion along *Z* direction. The second-order mode shape is the rigid motion along *X* direction. The third-order mode shape is the rigid motion along *Y* direction. The fourth-order mode shape is the torsion vibration around *Y* direction. The fifth-order mode shape is the pitching vibration around *Z* direction. Effective measures should be taken to avoid the resonance destruction of the screen box during the unloading phase of the dual-frequency vibrating screen.

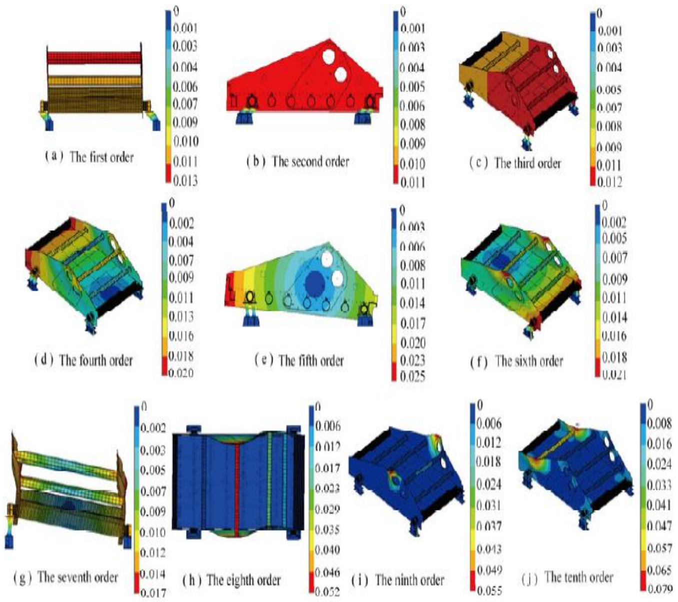

Fig 2.1 Mode shapes of vibrating box

3. HARMONIC RESPONSE ANALYSIS

Second model is used for the clear understanding of harmonic analysis.

To study the response of the structure for dynamic loading harmonic response analysis of the structure is carried out, stress distribution and areas of stress concentration can be analyzed by the analysis.

The stress distribution of screen box under working condition should be analyzed to avoid excessive stress concentration causing the screen box fatigued and damaged. In the course of screening, the screen box withstands gravity, exciting force from vibrating motor and the inertia force of the spring supports. In ANSYS, the stress level of screen box in working conditions can be obtained through harmonic analysis. Harmonic loads relates to the vibration isolation of the vibrating screen, transient loads may arise subjected to impact and impulse, while the periodic loads and random loads often used to describe wave motions which occur at random intervals. For any type of vibrating screen to perform its functions, there is always a vibration motion that occurs during its operation. From the knowledge of vibration Machines, it can be easily affirmed that the frequency of vibration of any vibrating equipment must not equal the natural frequency of the systems. When the resonance occurs, theoretically the amplitude is infinite; therefore it could lead to the damage of the screen structure or even cause high noise levels.

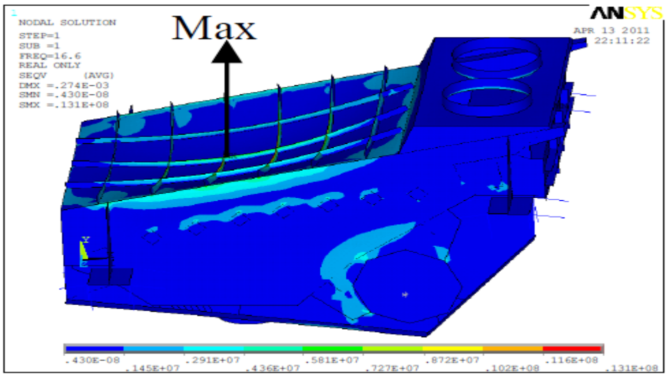

Fig 3.1-Stress distribution nephogram of real part

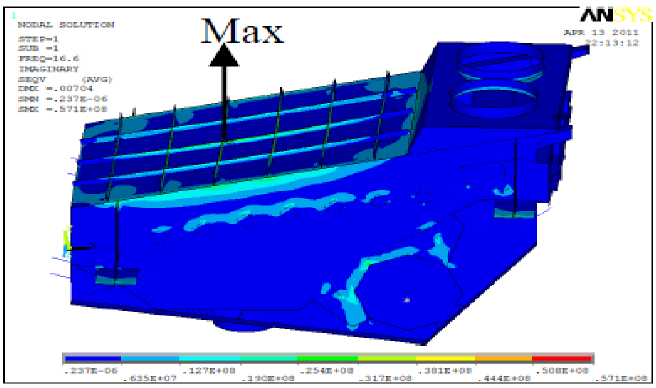

Fig3.2-Stress distribution nephogram of image part.

The real stress part meets the country allowable vibration stress requirement as 24.5Mpa It can be seen from Fig .3.1 that the real part of stress mainly concentrate in the ribs of cover ,the cover and both side plates, the connection part of hopper cover, the junction of shock vibration motor bearing and side plates.

3. CONCLUSIONS

(a) For model 1, Vibrating screen, the middle points' vibration displacements of the No.1 beam to No.6 beam, discharging beam and in-material beam increase with the growth of exciting frequency. There exists a flat region for vibration displacements when exciting frequency exceeds 13 Hz, and vibration displacements fulfill the amplitude signing requirement in the flat region.

(b) For model 2,Through the harmonic analysis, the stress distribution level of screen box is got. According to the analysis result of the harmonic response, some corresponding improvement are applied for screen box to make the stress distribution more even and region of stress concentration smaller to satisfy country allowable stress value 24.5 Mpa about vibrating screen equipment .

REFERENCES

1. Mr Boitumelo Ramatsetse "Failure and Sensitivity Analysis of a Reconfigurable Vibrating Screen Using Finite Element Analysis", "Case Studies In Engineering Failure Analysis".

2. Sergio Baragetti "Innovative structural solution for heavy loaded vibrating screens", Minerals Engineering 84 (2015) 15–26.

3. Yongjun Hou, Pan Fang and Lian Zeng," Finite Element Analysis of Dual-frequency Vibrating Screen", Advanced Materials Research Vols. 479-481 (2012) pp 2124-2128.

4. Liu Xinyong,Cui Hongbin,Cao Pengxian,Bao Xuechun,Liu Xinyu, "TQLZ Self-balance Vibrating Screen Static and Modal Analysis", Advanced Materials Research Vol. 852 (2014) pp 619-623.

5. Zhong-jun YIN, Lei ZHANG, Bing CHEN , "Kinematic and Dynamic Analysis of Large Coal Vibrating Screen" Applied Mechanics and Materials Vols. 105-107 (2012) pp 444-447.

6. DING Chuanguang, SONG Fangzhen, SONG Boand Men Xiuhua," The Finite Element Analysis of Vibrating Screen" Applied Mechanics and Materials Vol. 141 (2012) pp 134-138.

7. R.K. Luo, W.J. Mortel, X.P. Wu, "Fatigue failure investigation on anti-vibration springs" Engineering Failure Analysis 16 (2009) 1366–1378.

BIOGRAPHY:

Vishal Shrimandhar Masuatge
B.E
(MechanicalEngg.,WIT,SOLAPUR,Maharashtra,India)
M.TECH
(CAD/CAM/CAE,RIT,Islampur, Sangli.Maharashtra,India.)