International Journal of Current Engineering and Technology
E-ISSN 2277 – 4106, P-ISSN 2347 – 5161

Available at http://inpressco.com/category/ijcet

*Research Article*

# Finite element analysis of bandsaw swing frame of bandsaw machine

**Sonam S. Balighate* and S. V. Dhanal**

Department of mechanical Engineering, Sanjay Ghodawat Group of Institutions, Atigre, Kolhapur-416118, India

Received 12 July 2018, Accepted 15 Sept 2018, Available online 18 Sept 2018, **Vol.8, No.5 (Sept/Oct 2018)**

***Abstract***

*Band saws are most metal removing tool which can be applied to woods, plastics, aluminum and steels. In this work existing bandsaw is studied. The finite element analysis (FEA) of existing bandsaw swing frame is done. The section modulus of the section is calculated. According to conclusion drawn from analysis, a way to modify the frame is suggested. Also the FEA analysis of new bandsaw swing frame is done. The results of FEA analysis of both existing and new frame is compared considering various parameters such as vibration, deformation, speed, capacity.*

***Keywords:*** *Band saw, Band saw swing frame, Section modulus, FEA*

## 1. Introduction

A bandsaw (also written band saw) is a saw with a long, sharp blade consisting of a continuous band of toothed metal stretched between two or more wheels to cut material. They are used principally in woodworking, metalworking, and lumbering, but may cut a variety of materials. Advantages include uniform cutting action as a result of an evenly distributed tooth load, and the ability to cut irregular or curved shapes like a jigsaw. The minimum radius of a curve is determined by the width of the band and its kerf. Most band saws have two wheels rotating in the same plane, one of which is powered, although some may have three or four to distribute the load. The blade itself can come in a variety of sizes and tooth pitches (teeth per inch, or TPI), which enables the machine to be highly versatile and able to cut a wide variety of materials including wood, metal and plastic. Almost all band saws today are powered by an electric motor. Line shaft versions were once common but are now antiques. A band saw can be used to cut curves, even in thick lumber, such as in creating cabriole legs, to rip lumber and to crosscut short pieces. The most common use for the band saw, however, is in cutting irregular shapes. The second most common use is in resawing or ripping lumber into thinner slabs. A band saw also makes the smoothest cuts and, with the appropriate blade, can be used to cut materials other than wood, including metal.

Naguleswaran and Williams discussed parametrically induced lateral vibration of band saw blades. The parametric excitation is due to periodic variations in the band tension resulting from wheel eccentricity, and the existence of joints and flaws in the band. The conditions for stable operation are determined. Theoretical conclusions are verified experimentally.ByThompson and Taylor [3] an attempt is made to identify the wear mechanisms involved in power hacksaw blade wear the blade. The discussion includes some comments on the relevance of the procedures developed to blade wear testing.Soderberg andAhman[4]investigatedwear of bimetal band-saw blade teeth during the sawing of three important work materials (plain carbon steel, quenched and tempered steel and austenitic stainless steel) was. In band-sawing the blade life is determined by either a loss in cutting ability of the teeth or a lateral dis- placement of the blade.Wang and Mote, studied measurements of vibration on continuous bands driven by rotating wheels show coupling occurs between vibration of the band spans and wheel. An analytical model describing the vibration of the band/wheel system is presented. Sarwaret. al. reported an experimental data associated with forces, specific cutting energy and wear of high-speed steel bimetal bandsaw blades cutting 17-7 austenitic stainless steel bars.

In this work existing bandsaw is studied. The finite element analysis (FEA) of existing bandsaw swing frame is carried out to suggest the modifications in the development in the new frame.Also the FEA analysis of new bandsaw swing frameis done. The results of FEA analysis of bothexisting and new frame is compared considering various parameters such as vibration, deformation, speed, capacity.

## 2. Section modulus of band saw swing frame

The aim of project is to do structural design modification of existing bandsaw swing frame and

*Corresponding author P.G. Scholar is a PG Scholar (ORCID ID: 0000-0002-94546180); DOI: https://doi.org/10.14741/ijcet/v.8.5.7

development of new frame. The existing bandsaw m/c is horizontal bandsaw. The horizontal bandsaw m/c consists of driving wheel and driven wheel. The blade is rapped on driving wheel and driven wheel. When it comes near the job holding attachment it gets tilted and become straight. The motor of 1 H.P. is used. The blade tension adjusting knob is provided which keeps proper tension between driving wheel, driven wheel and belt. The hydraulic cylinder is used for speed adjustment. The coolant is continuously provided for cooling purpose. The frame is made up of CI grade 25. Its right end is fixed and left end is getting vertically up and down. This is manual m/c the operator has to feed job manually.The section modulus of middle section is calculated. The stresses acting are compressive type show by arrow.

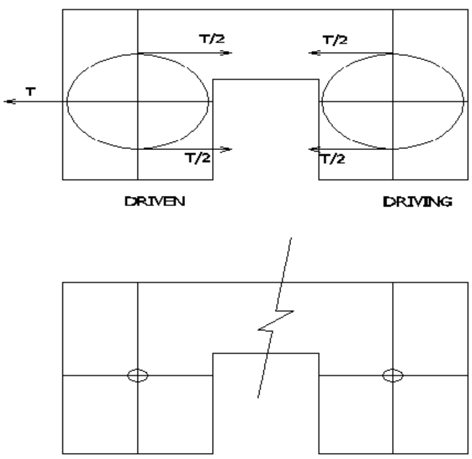



**Fig.1** Forces acting on frame


**Fig.2** Existing bandsaw machine

*2.1 Section Modulus of Existing Frame*

Section modulus is a geometric property for a given cross-section used in the design of beams or flexural members. Other geometric properties used in design include area for tension and shear, radius of gyration for compression, and moment of inertia and polar moment of inertia for stiffness. Any relationship between these properties is highly dependent on the shape in question. Equations for the section moduli of common shapes are given below. There are two types of section moduli, the elastic section modulus (S) and the plastic section modulus (Z).

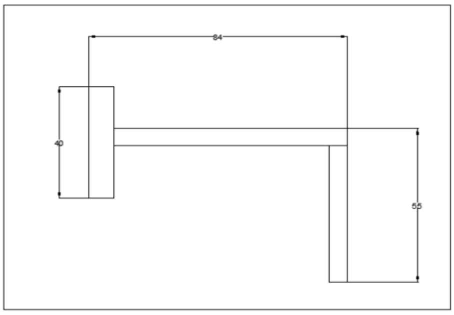


**Fig.3**Existing Frame section

Combined section modulus= Z1+Z2+Z3=2133.33+456+2500=5089.33mm$^3$
Maximum bending moment=724.19 * 10$^3$ N-mm
Bending Stress ( $\sigma_b$ ) =142.29 N/mm$^2$

*2.2 Section Modulus of New Frame:*

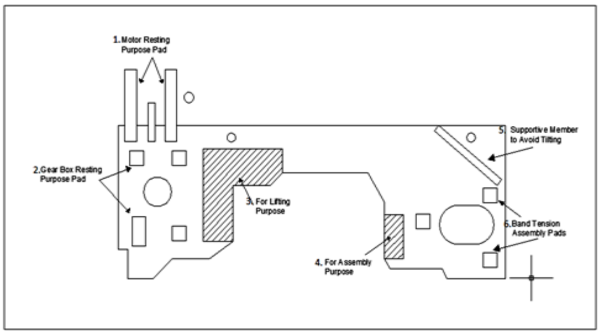
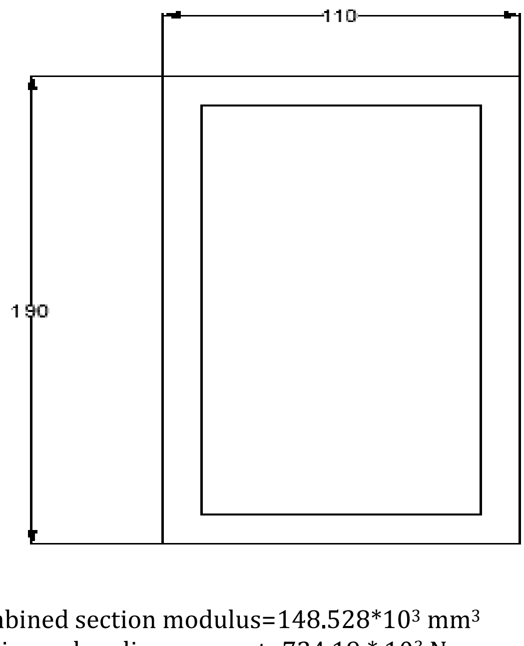



**Fig.4** Nomenclature of New frame




Combined section modulus=148.528*10$^3$ mm$^3$
Maximum bending moment=724.19 * 10$^3$ N-mm
Bending Stress ( $\sigma_b$ ) =142.29 N/mm$^2$

## 3. FEA of Bandsaw Swing Frame

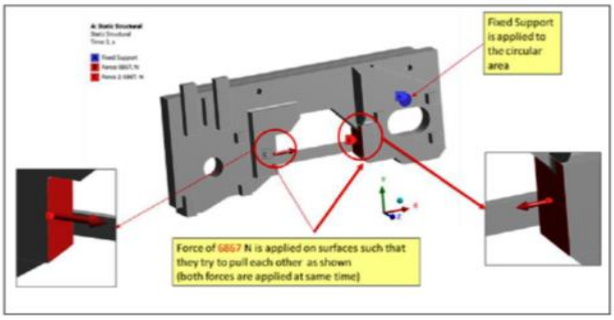


**Fig.5** Boundary conditions

Mesh generation

| Details of "Mesh" | |
|---|---|
| ⊞ Display | |
| ⊞ Defaults | |
| ⊞ Sizing | |
| ⊞ Inflation | |
| ⊞ Patch Conforming Options | |
| ⊞ Patch Independent Options | |
| ⊞ Advanced | |
| ⊞ Defeaturing | |
| ⊟ Statistics | |
| Nodes | 265617 |
| Elements | 154760 |
| Mesh Metric | None |

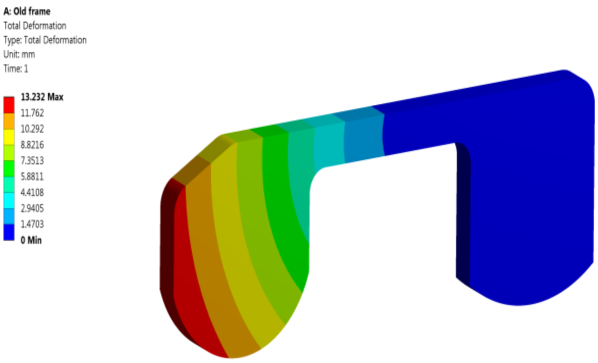



**Fig.6** Deformation of frame under loading

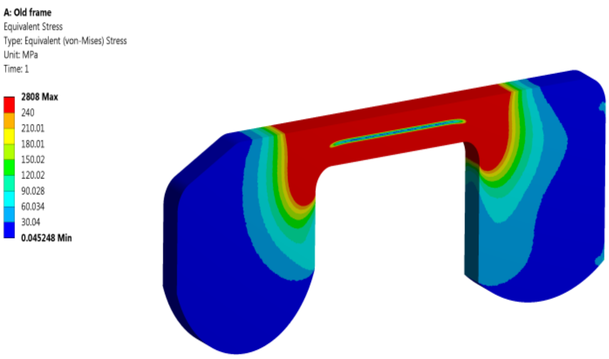



**Fig.7** Von mises equivalent stress

Von mises equivalent stress is exceeds the material ultimate strength of 240 MPa.Red region in picture indicates failure of material as von- mises stress exceeds material strength of 240 MPa.

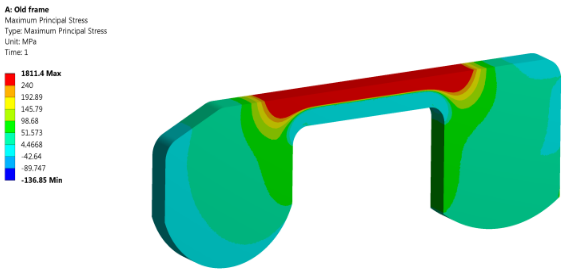


**Fig.8** Minimum principal stress

Minimum principal stress exceeds the material strength of 240 MPa. Red region shows failure as minimum principal stress exceeding material strength.

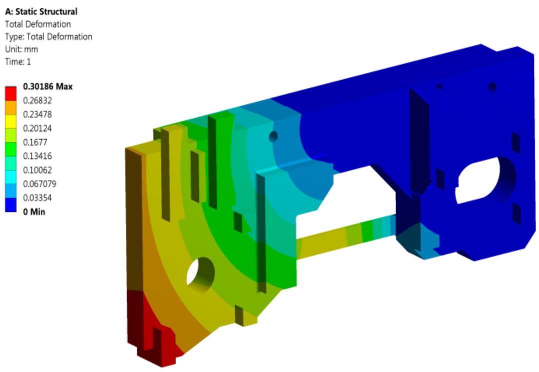
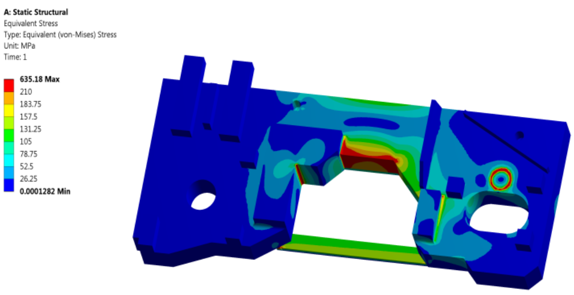



**Fig.9** Deformation of frame under loading condition



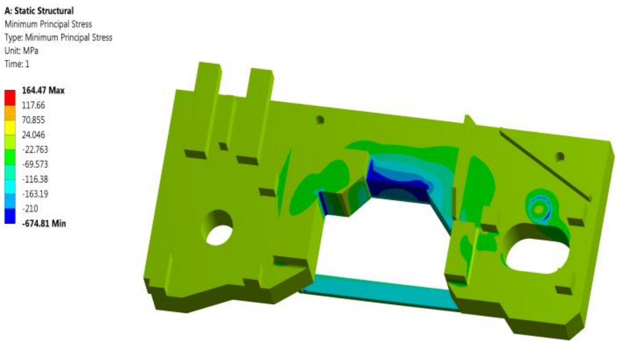




**Fig.10** Minimum principal stress

Minimum principal stress is exceeds the material yield strength of 210 MPa. Red area in picture indicates failure of material as minimum principal stress exceeds material strength of 210 MPa.

**Table1**. Comparison between existing and new Frame

| Sr.No | Parameter | Existing Frame | New Frame |
|---|---|---|---|
| 1. | Total Deformation | 13.22 mm | 0.3018mm |
| 2. | Equivalent Stress | 280.08 MPa | 635.18MPa |
| 3. | Min.Principal Stress | 34.52 MPa | 164.47MPa |
| 4. | Max.Principal Stress | 1811.4 MPa | ---- |

## Conclusion

The cutting speed and accuracy of existing bandsaw is less. Due to inaccurate cutting the machine contains lot of vibrations. The maximum cutting capacity is 150 mm. The material wastage is 1.5 mm for this machine. The weight of frame is approximately 75 kg.The new machine is having more speed than existing machine. Due to accuracy of cutting the blade life increase and vibrations are less. The frame is double column type means the movement is parallel. The maximum capacity of cutting is 250 mm. The material of frame is mild steel. Once program is given to machine the arm cuts the bar with repetition. It does not require initial more time for programming and loading. The material wastage in this machine is negligible up to 0.1 mm. The weight of new frame is approximately 160. The FEA results shows that the new frame has less deformation than the existing frame. The equivalent and principle stresses are more than the existing frame.

## References


Naguleswaran, S., and Williams, C. J. H. (1938), Lateral Vibration of Bandsaw Blades, Pulley Belts, and the Like, International Journal of Mechanical Science, Vol. 10, pp. 239-250.

P. J. Thompson (1974), A theoretical study of the cutting action of power hacksaw blades, Int. J. Mach. Tool Des. Res. Vol. 14,pp 199–209.

P. J. Thomson & R.W. Taylor (1976), An investigation into factors influencing the wear rate of power hacksaw blades using dimensional analysis

Soderberg, S., and Ahman, L (1983), A Metallurgical Study of the Wear of Bandsaw Blades, Wear, 85, pp. 11–27

K. W. Wang and C.D. Mote (1985) Vibration coupling and analysis of band/wheel Mechanisms.Journal of Sound and Vibration.109(2), 237-258

Andersson, C., Andersson, M. T., and Stahl, J.-E. (2001), Bandsawing. Part 1: Cutting Force Model Including Effects of Positional Errors, Tool Dynamics, and Wear, Int. J. Mach. Tool Manuf., 41, pp. 227–236

M. Sarwar, M. Persson, H. Hellbegragh (2007) Wear and cutting edge in the bandsawing operation when cutting austenite 17-7 stainless steel

M. Sarwar, JulifkarHaider (2010) Aspects of burr formationin bandsaw teeth manufactured by milling operation

Essam Ali Al Bahkali, Adel Taha Abbas ( Jan 2016) Failure Analysis of Vise Jaw Holders for Hacksaw Machine Journal of King Saud University, Engineering Sciences

M. sarwar, M. Persson, H. Hellbegragh (2005) Wear and failure modes in bandsawing operation whe cutting ball bearing steel