TECHNICAL UNIVERSITY OF CLUJ-NAPOCA

ACTA TECHNICA NAPOCENSIS

Series: Applied Mathematics, Mechanics, and Engineering
Vol. 62, Issue I, March, 2019

STUDY OF THE MANUFACTORING PRECISION ON TURNING MACHINE WITH INCLINED BED FRAME IN REAL TIME OF PROCESSING

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Abstract: *The comparison of the reaction of welded and molded bedframes being exposed at dynamic excitation during the manufacturing process and calculating context and own frequencies who are determining the final bedframe vibrations absorption capacity is the key to obtain high precision in manufacturing. We researching how to define new types of structures with two main qualities: controlled deformations easy to predict and therefore to correct with the clear purpose to get the „ideal" product and right materials and way of manufacturing the structure itself in order to obtain lower vibration levels.*
Key words: *Lathe, dynamic study of inclined bed frame, variables factor parameters affecting the global precision, displacements in cutting cross section where the tool is acting and generates in fact the manufacturing precision, welded, molded.*

1. INTRODUCTION

It may be considered not very difficult to design a whole tool machinery that in theory will be highly accurate as results achieved in manufacturing precision and it can look that it is not very difficult to get the way that the final result fulfil not any local constrain but the principle of obtaining the perfect cutting piece that of course is just an ideal, practically to obtain dimensions and quality of surfaces as close as possible to the requested one with minimum effort. The solution of increasing the rigidity of the structure with the purpose to obtain higher precision in the process of manufacturing is to over dimension the structure and obtain minimum deformations [1], [2], [3]. Having harder structures has as a consequence the increase of the quantity of the material used to build the structure, increase of total weight and significantly higher costs. In the modern industrial era this point of view is not accepted anymore especially due to the great achievements that the computer zone and artificial intelligence have suffered [4].

The last idea was developed in our previous papers [2], [5].

The real difficult challenge is to ensure the manufacturing high precision in a dynamic process where the small unevenness can appear unexpectedly and affect the whole theory that is based on constant structures, homogenous materials and other ideal theory hypothesis [5], [6].

In case of a free unsustained vibration the equation of dynamic equilibrium of the vibrating movement can be defined as [7], [8]:

$$m\ddot{x} + c\dot{x} + kx = 0 \tag{1}$$

Where:
m=mass
c= amortization factor
k=elastic constant
$\ddot{x}$ = acceleration
$\dot{x}$ = speed
x = displacement

Dividing by m and defining c/m = λ and k/m = p^2 we obtain [7], [9]:

$$\dot{x} + \lambda\dot{x} + p^2 x = 0 \quad (2)$$

In which
p=pulsation of the system

$$p = 2\pi * f_z \frac{2\pi}{T} \quad (3)$$

Where:
f= frequency of oscillation
T=period of oscillation

Solving the differential equation leads to the following results which give information about the movement [1], [9], [10].

The amplitude of the vibration at the initial moment is:

$$x_1 = x_0 e^{-\lambda_t} \quad (4)$$

The amplitude of the vibration after moment T, meaning before complete amortization is:

$$x_2 = x_0 e^{-\lambda_T} \quad (5)$$

The intensity of the amortization is derived from two successive amplitudes:

$$\frac{x_1}{x_2} = e^{\lambda_T} \quad (6)$$

The natural logarithm of the above division is the logarithmic decrement of the amortization:

$$\delta = lm \frac{x_1}{x_2} = \lambda_T \quad (7)$$

The logarithmic decrement δ leads to the amortization factor λ :

$$\lambda = \frac{\delta}{T} \quad (8)$$

2. EXPERIMENTAL WORK

Using a rubber hammer the impulse signal was applied to the stick structure in the area of the fixed and mobile doll during the manufacturing process [11].

The impulse was applied both vertically and horizontally. The response of the bedframe to the impulse were collected using a seismic logging traductor.

The response was collected for each level and impulse application spot, both vertically and horizontally.

From the registered impulse we obtained the amplitude of the vibration, the period of oscillation, and the amortization period. Using these variables, we obtained the amortization intensity δ, the amortization factor λ, and the response pulsations p [1], [11].

3. RESULTS AND DISCUSSIONS

The response frequencies on the right-hand side (Table 1 and Table 4) have the same excitation and response values as the ones on the left-hand side (Table 2 and Table 3).

The welded bedframe shows higher response frequencies, unlike the molded one. Left side of the bedframe excitation and response.

The response frequency to the vertical impulse at the welded bedframe was 40 Hz, with a higher vertical amortization period (150 ms) than horizontal (35 ms).

The response frequency to the vertical impulse at the molded bedframe was 20 Hz, with an approximately equal vertical amortization period as horizontal.

By comparing the welded and molded bedframes, we notice that the molded bedframe has a greater amortization factor λ.

The horizontal impulse tells us that the response frequency and amortization period is smaller than that of the vertical impulse.

By comparing the amortization factors, we notice a greater λ for the welded bedframe than for the molded one.

By comparing the amortization factors λ, we notice a better amortization for the welded bedframe.

Table 1

Stress nearby the right part of the structure and horizontal impulse

	Vertical impulse			
	Vertical answer		Horizontal answer	
	B.S.	B.T.	B.S.	B.T.
T_1 (ms)	150	175	35	110
T_2 (ms)	25	50	25	50
f_1 (Hz)	7	6	29	9
f_2 (Hz)	40	20	40	20
p_1 (rad/s)	44	38	182	57

p2 (rad/s)	251	126	251	126
$\bar{x}_i$	2	2,2	1,1	1,2
x_{i+1}	1,6	1,5	0,5	1,0
δ	0,2	0,3	0,8	0,3
$\lambda\,10^{-3}$	1,4	1,7	11,4	2,5

Table 2

Stress nearby the left part of the structure and horizontal impulse

	Horizontal impulse			
	Vertical answer		Horizontal answer	
	B.S.	B.T.	B.S.	B.T.
T_1 (ms)	35	120	56	80
T_2 (ms)	18	50	18	50
f_1 (Hz)	29	8	20	12
f_2 (Hz)	56	40	56	20
p_1 (rad/s)	182	50	126	75
p_2 (rad/s)	352	251	352	126
$\bar{x}_i$	1,0	1,2	1,4	1,2
x_{i+1}	0,7	0,9	1,2	0,5
δ	0,4	0,3	1,5	0,9
$\lambda\,10^{-3}$	11,4	2,5	26,7	11,2

Table 3

Stress nearby the left part of the structure and horizontal impulse

	Vertical impulse			
	Vertical answer		Horizontal answer	
	B.S.	B.T.	B.S.	B.T.
T_1 (ms)	150	130	35	120
T_2 (ms)	25	50	25	50
f_1 (Hz)	7	8	29	8
f_2 (Hz)	40	20	40	20
p_1 (rad/s)	44	50	182	50
p_2 (rad/s)	251	126	251	126
$\bar{x}_i$	1,6	1,3	1,1	1,1
x_{i+1}	1,1	1,1	0,7	0,6
δ	0,4	0,2	0,5	0,6
$\lambda\,10^{-3}$	2,6	1,5	14,3	5

Table 4

Stress nearby the right part of the structure and horizontal impulse

	Horizontal impulse			
	Vertical answer		Horizontal answer	
	B.S.	B.T.	B.S.	B.T.
T_1 (ms)	35	50	B.S.	B.T.
T_2 (ms)	18	20	65	80
f_1 (Hz)	29	20	18	20
f_2 (Hz)	56	50	15	12
p_1 (rad/s)	182	126	56	50
p_2 (rad/s)	352	314	94	75
$\bar{x}_i$	1,2	0,9	352	314
x_{i+1}	0,8	0,6	1,1	1,1
δ	0,4	0,4	0,8	0,8
$\lambda\,10^{-3}$	11,4	8	0,3	0,3

4. CONCLUSIONS

As presented in previous papers single-cast inclined bed lathe with a low point of gravity ensure high rigidity, allow large diameter rotation and a good material manufactured removal, easy access to the track, good stability and high vibration absorption capacity. The main spindle is specially designed to allow high precision and to take up radial and axial loads.

At low speed in each range on frameworks vibration levels are about the same cast and welded horizontally and vertically.

At higher speeds vibration levels to the framework of each game cast is slightly larger than the welded machine frame.

At the next level, with the machine working under some unstable conditions related to the piece material and cutting depth our supposals when projecting all systems were confirmed, the machine was acting well with hard working parameters and under some unstable conditions due to in essence that in theory all is linear, respecting the same pattern, ideal.

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STUDIUL PRECIZIEI DE FABRICARE A MAȘINII DE STRUNJIRE CU CADRU DE PAT ÎNCLINAT ÎN TIMP REAL DE PROCESARE

Rezumat: Compararea reacțiilor batiurilor în construcție sudată sau turnată solicitate la darcini dinamice în timpul procesului de prelucrare precum și calculul modului și frecvențelor proprii care vor pune în evidentă capacitatea de absorbție a vibrațiilor este factorul esențial pentru obținerea preciziilor înalte de prelucrare. Echipa noastră de cercetare încearcă să definească noi tipuri de structuri care să satisfacă doua cerințe esențiale: să aibă deformații controlate, ușor de anticipat și în consecință de corectat în scopul evident de a obține un produs ”ideal” și să fie realizate din materiale care să permită atenuarea rapidă a vibrațiilor. În publicațiile precedente au fost analizate structurile realizate prin sudare sau structuri turnate în încercarea de a stabili avantaje și dezavantaje ale acestora în utilizarea la fabricarea batiurilor, fiind luate în considerare aspect legate de proiectare, realizarea batiurilor și comportamentul acestora în timpul prelucrării pe mașina unealtă care folosește respectivul tip de batiu.

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