A NEW VISION ABOUT THE DIMENSIONING CALCULUS FOR THE FRAME OF THE COLD MILL MACHINE

Stefan DRAGOMIR, Georgeta DRAGOMIR

“Dunarea de Jos”University of Galati,
email: doromir@email.ro

ABSTRACT

Dimensioning calculus for a rolling mill machine frame, using resistance classical methods allows determines the introduction of errors .For to do a better precisely of calculus we propose to use “Finish Elements Method”. In this work also is made a comparation between the classic calculus method and the resistance frame mill calculus with the new method and the implications that result from these.

KEYWORDS: frame, rolling mill, finished element method

1. Introduction

The sheet or strip made from refractory steels and stainless steels are manufactured in a cold or hot rolling mill machine.

The type of rolling mill and afferent equipments are interested because is necessary to obtain a product that respects the specifications for the dimensions and quality.

When we laminated stainless and refractory steels the frame of mill machine is very tensioned and in time appear the “micro crash” –at the inn of the frame corner- who caused major damage at the body cage.

The two frames that are the most important element of the mill cage, are assembled by traverses with screws –for fixed on the plate support of cage-.

The weight of the frame is nearly 450tons and the rolling force in work is approx.120MN.The engines for acctionnary the work rolls have 2x10MW power.

In this work is shown a rigorously dimension calculus for the frame of the reversible cage with dimensions (430x1270x1250mm) and the sheet processed (thickness,1-5mm and breath 1000x2000mm).

In calculus it was taken in consideration the deformability characteristics of laminated sheet, in correlation with cage resistant capacity.

2.Calculus and experiments

Into the classic calculus of dimensioning for the frame the most important force that deformes the frame in time of work is the force of sheet deformation (the direction of action is in a vertically plan).

The formula that was used is (Telicov):

Force of laminated:

$F= b\sqrt{R \cdot \Delta h}$. pmed [N]

$\Delta h=h_1—h_2$ [mm]

were: b is sheet breath;

R is work roll radius;

h1, h2 are thickness of rolling sheet before and after the rolling mill process; pm is the average resistance for deformation of rolled material.

The frame is made from low alloy cast, with the next characteristic:$Rm=530\text{-}790N/mm^2$; $Rp=295N/mm^2$; A=18 %.

The section of measured frame column is $0,57m^2$

The preliminary work hypothesis is that the mainly force who can deform the column and traverse of frame is the force on the work roll. In the rolling process is developed horizontal force
(small values) in direction of sheet plan.

Because a cage has two frame the mainly force is divided in two like:

Fy = Flmax/2

In figure no.1 and no.2 is shown the constructive aspects of frame.

After the calculus result the bending moments on the upper traverse $M1 = 11{,}3 x 10^9$ Nmm.

For columns the maximum effort (bending and stretching),

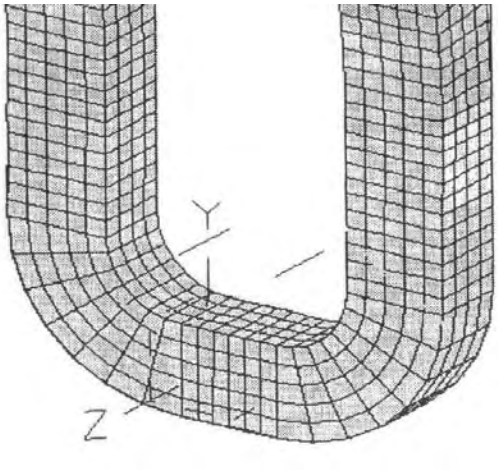

Fig.1.*Finish elements structure discretisation*

$$\sigma int = \sigma_1 + \sigma_2 = Flmax / 2A_2 + Mo / W_2 \quad [N/mm^2]$$

$$\sigma int = 12{,}8 \ N/mm^2$$

were:

W_2 , W_1 is the resistant modulus of column, in cm^3 ;

A_2 – transversal section area of column, in cm^3

E – longitudinal elasticity modulus for cast steel ($E = 1{,}75 x 10^6$ N/mm^2).

In the upper traverse the maximum effort of bending through (section I-I, nut zone of pressure screw) can be found :

Mo =Fy.l1[1+4r(1,15r.I1/l1I2+1)]/2
Mo =$8{,}95 x 10^8$ Nmm
M_1 =Flmax.l1/4 – Mo;
M_1 =$73{,}2 x 10^8$ Nmm

The real stress measured -in the milling process- into the cage frame was:

$\sigma_{int} = 21{,}7 \ N/mm^2$, on the column of the frame;

$\sigma_{max} = 26.3 \ N/mm^2$, on the traverse of the frame.

The admissible resistance is for the frame material $\sigma a = 45\text{-}55 \ N/mm^2$. During the functionary is necessary to take in consideration the durable resistance of frame material.

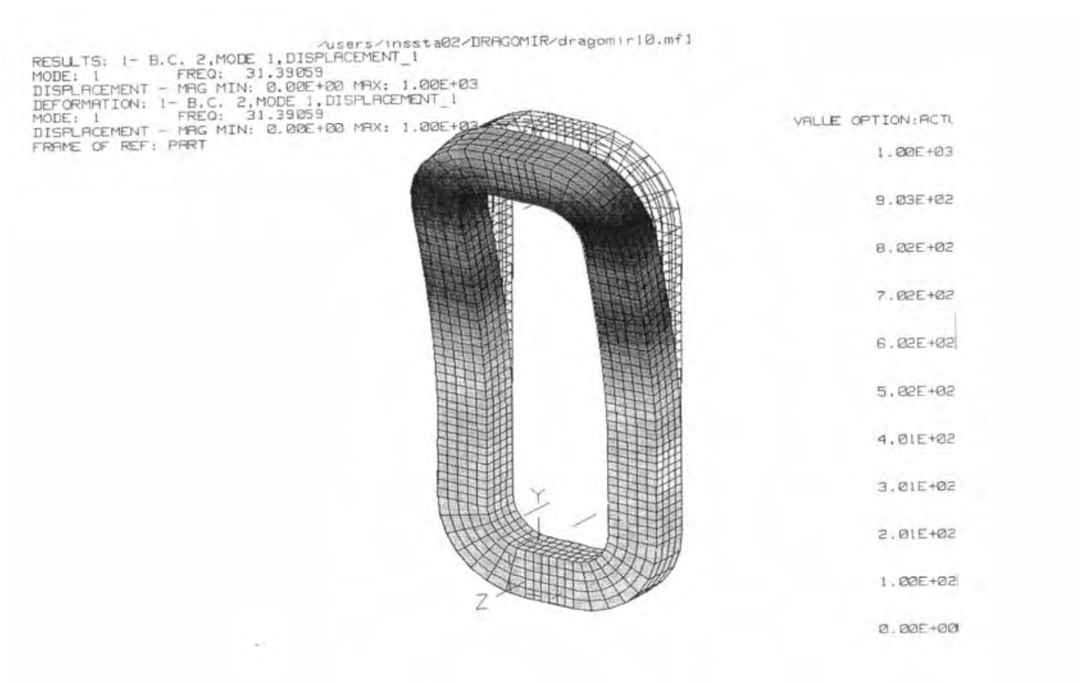

Fig.2.*Finished elements method analyzed for the frame cage*

On the upper of the frame (superior traverse) is positioned the hole for pressure screw nut. In this zone (section I- I), it is an important stress concentrator.

Using "the method of finished element" we made a complete verification (resistance of material) for the cage frame.

This method offers a calculation algorithm for the frame whose structure was made from bars (three dimensions) and like charges are used static and dynamics tensions.

For apply "the method of finished element" is necessary to discretisation the structure who must be verified in small triangular, rectangular or circular elements with subprogram "MASTER MODELLER".

After the definition of the structure with its geometrically characteristics, we can applies the tensions .The program made automatically redistribution of local "accidents". The program numbers the nodes on which shifting and efforts are calculated (starting from the maximum rolling force), in each side of established element.

3.Conclusions

By comparing the results obtained with a classic calculus (resistance) for the frame of mill cage for cold strip (refractory and stainless steel), and a verifies calculus with method of finished element, we can say that:

- the columns of the frame have the section with 13,2% increased ;
- the traverse of the same frame have the section increased with 17.8% (the new method of calculus take in account and the fatigue calculus[3];
- it can say that the weight of the frame is much that is necessary, because the section is artificially increase and it is a result of the classic calculus;
- the maximum of tension calculated by this program is in the nut screw zone (upper traverse of the frame);
- using the method of finit element, the calculus time, is with 60% less than if we applies the classic method of calculus for frame dimensioning.

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