FEA Analysis of stresses and deflection induced in rollers of re-rolling mills.

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ABSTRACT

FEM Analysis is a numerical method that can be used for the accurate solution of complex engineering problem. Rollers of Re-Rolling milling are the rigid structural rotating elements used in production of different kinds of Geometry of products which are used in the various places like in Construction, in welding, etc. Rollers are also the main element of industry (mill) which is responsible for manufacturing of final products produced by mill. Rollers are the elements which are fixed from both the sides in the rolling stand &allow to reflect in upwards or downward direction like a simply supported beam.

In these paper the structural analysis of roller of re-rolling mill by using FEA technique to get the range of deflection and stress for a definite pressure of 20mpa in the commercial software like ansys.

Keywords: Rollers, stress & deflection

I. INTRODUCTION

The FEM method was first developed in 1956 for the analysis of aircraft structural problem. Nowadays, this method has become active research area for applied mathematics & complex engineering. Problem. In this analysis once a general model is developed it can be used for solution of any problem related to that model by simply changing the parameter. This method can be used in commercial software like NASTRAN & ANSYS.

The basic idea of applying FEM method on rolling mill's roller is to estimate the particular range of stress and deflection up to which a roller can be easily used. A roller is a structural rotating element which is like a brain of industries all the final product depends on quality of rollers. We are applying the FEA analysis on an industrial roller of Mahalaxmidhatuudyogpvt.& ltd.Our aim is to determine the maximum value of stress and deflection up to which a roller can be continuously used in a proper way without harming the final product.

The second reason for selecting this project among the various problems present in the industry mentioned above is that we want to save the industry from huge lose in the breakdown period which generally Occurs in such industries because of roller

breakdown & also to save the operator,operating the rollers from any harm when roller breakdown.

II. Relevant LiteratureReview:-

1. **Charles Mansfield, Ali P. Gordon :**Manufacturers of rolled materials are always striving to reduce the costs associated with production-be they time, material, or waste. A parametric study was conducts via ANSYS and LS-DYNA to numerically simulate symmetric hot rolling. Conditions that minimize edge cracking as predicted by a ductility model are presented.

2. **Imre Kiss, VasileAlexa, Vasile George Cioata:**

   The paper proposes to evaluate the thermal stresses produced by the temp fields in the hot rolling mill using experimental date. The research of the thermal stress that action in the rolling rolls is impetuously necessary not only to diminish the fissures caused by thermal fatigue, to increase the exploitation duration, but also to avoid thermal shocks, which are very dangerous in the exploitation process and produced by large variation.

3. **Wenyan Yu, Lei Qiang:**

   According to rolled plate situation of finishing mill roll of a steel mill, the large finite element analysis software ANSYS is used to establish the working process of the roll of three dimensional thermal coupling model. It is also put into consideration that the actual process of the simulation should define the boundary condition.

4. **Matthias Dunckelmeyer, Christian Krempaszky, Ewald Werner, Gerald Hein, Kari Schorkhuber:**

   This paper calculated thermal induced residual stresses are related to the mechanical properties of the roll's material. Analytically calculated temperature distributions on the roll surface are predicted by the model and compared with experimental results.

5. **GargiMajundar and Kaushik Kumar**

   The paper in which the beam is taken massless and inexistible because of which it develops no strain. This cantilever beam is subjected to a vertical point load at the free end and the differential equation is developed mathematically.

III. Material Used:-

The material used in the industry for the roller is European North 8 generally called as EN8, which is medium carbon usually supplied untreated. It has a good tensile strength in generally used in applying such

as shafts, gears, bolts etc. EN8 is very propeller great and really machine able in any condition. The US grade of EN8 is SAE 1040.

Specification of EN8

Chemical composition table

Carbon	0.3624 – 0.44%
Si	0.10 to 0.40 %
MN	0.60 to 1%
S	0.05 Max
K	0.05 Max
Cr	-
Mo	-
Ni	-

Mechanical Properties

Maximum Stress	700 pa
Yield Stress	465 pa.min.
Elongation	16% min
Hardness	201 to 255 BHN
E	2e5
μ	0.3

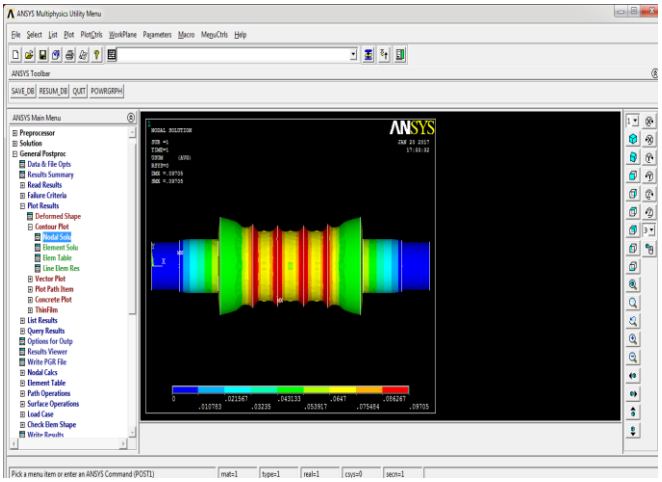
IV. FEA ANALYSIS:

As mention early FEA analysis can be used in commercial software line ANSYS, NASTRAN etc.

NASTRAN it is software developed by NASA it is totally based on numerical method, Non-linear finite element problem for structural analysis of element at various point.

ANSYS: - American CAE software developed by company named ANSYS Inc. it include FEA analysis, structural analysis, CFD, explicit & implicit method, & heat transfer

In these project we are using ansys software to obtain a range of stress and deflection by doing a structural analysis on roller in software like ansys. For that an element we are using Tet10node187 as mention in our reference paper published by GargiMajunder and Kaushik Kumar as mentioned in literature review section. The material properties that we used here is E (young's modulus of elasticity) = $2*10^5$ mpa& μ (Poisson's ratio) = 0.3.the figure below shows the deflection and stress distribution



F1ig No.2:- Deflection distribution.

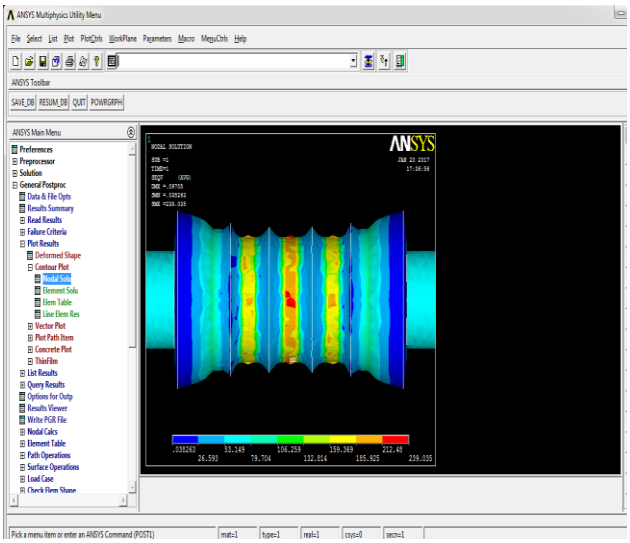


Fig.No.3:- Stress Distribution

V. THEROTICAL CALCULATION:

Using the Bernoulli-Euler's elastic curve equation the following relationship is obtained

$$EI\,(d^2y/dx^2) = M$$ [1]

Where,
E is modulus of elasticity which is of constant value.is moment of nertia=bh3/12,b=width of beam, h=height of beam.M=moment developed.
Cantilever beam of length L subjected to a vertical point load 'F' at its free end. [1]

The B.M. equation at section X-X at a distance x from fixed end is given by:

$$EId^2y/dx^2 = -F\,(L-x)$$

On integrating and solving the above eq. with required boundary conditions we get the downward deflection of beam as:
$FL^3/3EI$.

Examples:-
Assuming L=100m, b=10m, h=10m, ν=0.3, $E=2\times10^5 N/m^2$, F=500N.
Analytic Deflection, δ_B= 1.000004 m.

Using the equation: (M/I) = (E/R) = (σ/Y), Analytic Stress developed $\sigma_B=300N/m^2$.

VI. CONCLUSION

It is concluded that from above data, the deflection and stress value for roller of mill for 10 node tetrahedral elements is 0.09705 mm & 239.329mpa.It also states that it is applicable to general loading conditions.

VII. REFERENCE

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