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The Simulation of Rolling Process of Wire with Y-Type Roller

MA Jin-Hong[1,a], TAO Bin[1],YAO Xiao-Han[1]

College of Metallurgy and Energy, Hebei United University,Tangshan, 063009, China

[a]email: majinhong@126.com

Keywords:Y-Type Roller; Wire;Rolling Process Simulation; ANSYS/LS-DYNA

Abstract. Y-Type rolling mill with three roller is a new kind of wire mill.The three-dimensional models of rolling are established by Pro/E. Based on the finite element analysis software ANSYS/LS-DYNA, the rolling process of wire by Y-type rollers is simulated. The rolling piece movement is analysed. Stress and strain of Y-type roller are also analysed.

Introduction

Wire production has developed very fast in recent years, from small mill to continuous mill and semi- continuous. High speed wire mill has now become mainstream, Capacity and production are 50% more than that of total amount. The urgent demand for wire production in view of the market, the requirement of wire mill increases. Three rollers Y type mill is shown in Fig. 1. The roller structure sketch is shown in Fig.2. Because of its special deformation way can make the workpiece maintaining high precision and high surface smoothness[1].

. The stable rolling process of wire is important. In this paper, the rolling process is simulated by FEM software of ANSYS/LS-DYNA[2][3]. The stress and strain distribution in the roller are analyzed.

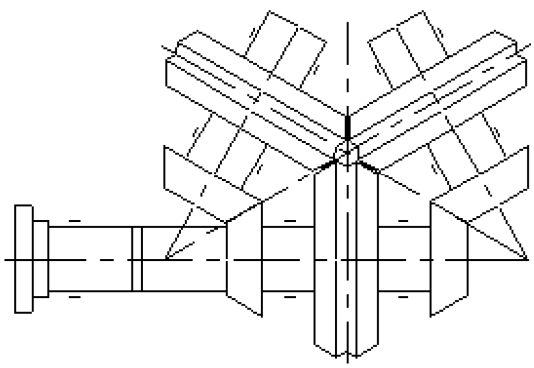


Fig.1 Y rolling mill

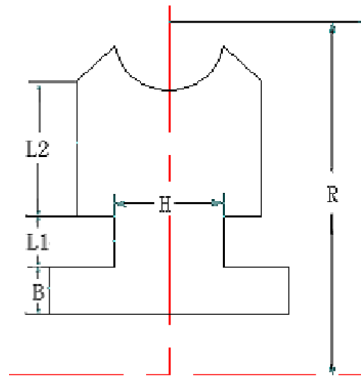


Fig.2 The section of roller

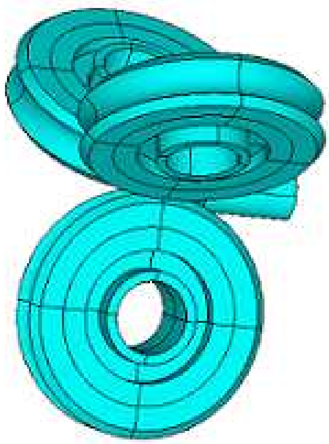


Fig.3 Drawing of geometrical model of Pro/E

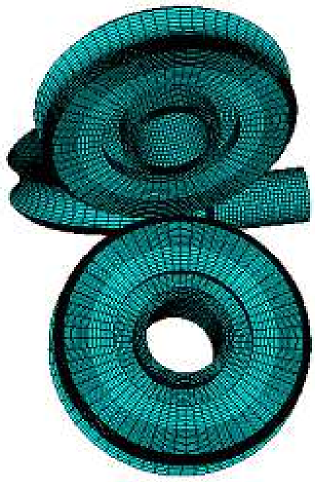


Fig.4 FEM model

FEM Model

The entity model is established by Pro/ENGINEER Wildfire, as shown in Fig. 3. The solid model is used to simulate the rolling process of wire with three roller of Y-Type mill. The model will be saved as a LS-DYNA compatible format, and imported into solid model. The initial roller values of main parameters are B=13, H=18, L1=20, L2=43, R=125. FEM model is shown in Fig.4

For the billet, the isotropic exponential hardening elastic-plastic model is adopted[4]. The material reaches yield limit, then strengthens along the linear hardening. Material needs to define the density, elastic modulus, Poisson's ratio, yield stress and shear modulus, these are as shown in Table 2. The data is obtained at the temperature of 1000°C. The material stress-strain model is as shown in Fig.5.

Table 1 Parameter of material characteristic

density(kg/mm^3)	elastic modulus(kPa)	Poisson's ratio	Initial yield stress(kPa)	shear modulus(kPa)
7.85E-6	1.17E+8	0.36	1.38E+5	1.3E+4

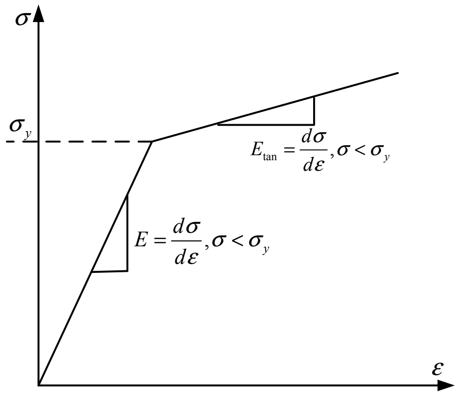
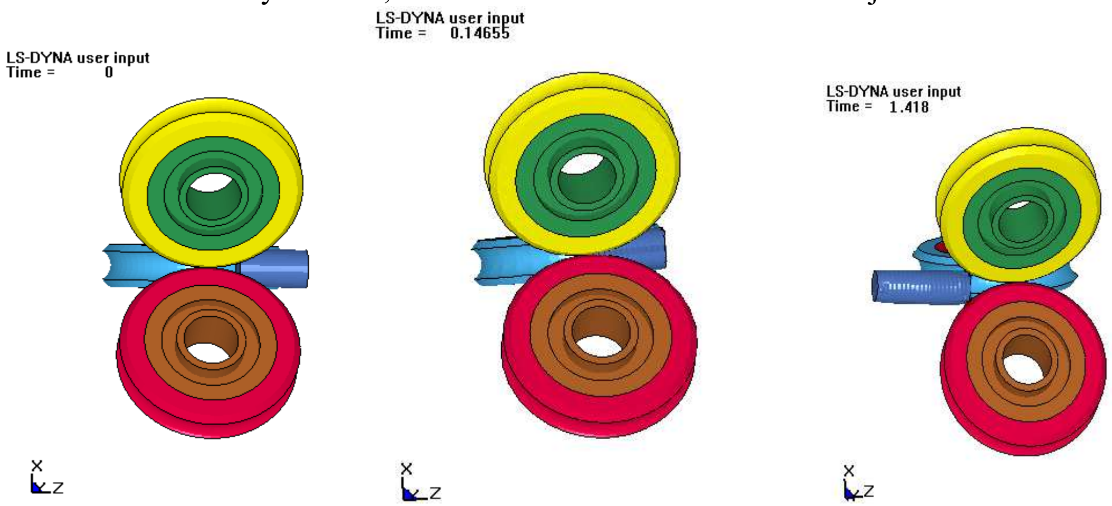


Fig.5 Stress-strain model of material

Simulation Results Analysis

LS-PREPOST software is used for Postprocessing, the bite process of wire can be clearly seen from Fig.6. 6(a) is the initial stage of rolling, 6 (b) the bite stage and 6(c) is post-rolling stage. The Von-Mises stress rolling process of roller, the strain contour are respectively shown in Fig.7 and Fig.8. Three direction displacement of roller are respectively shown in Fig.9, Fig.10 and Fig.11. Because three roller are symmetric, one roller are selected as research object.



(a) (b) (c)

Fig.6 The movement situation of workpiece in the process of rolling

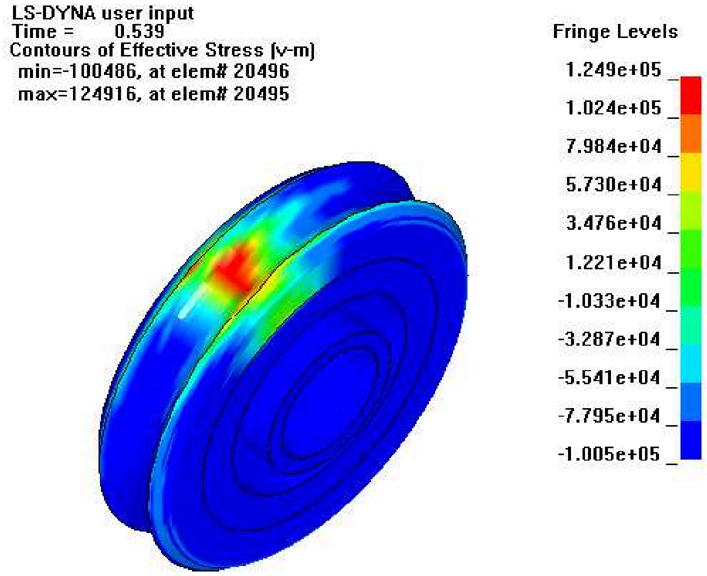


Fig.7 Von-Mises stress of roller in the rolling process

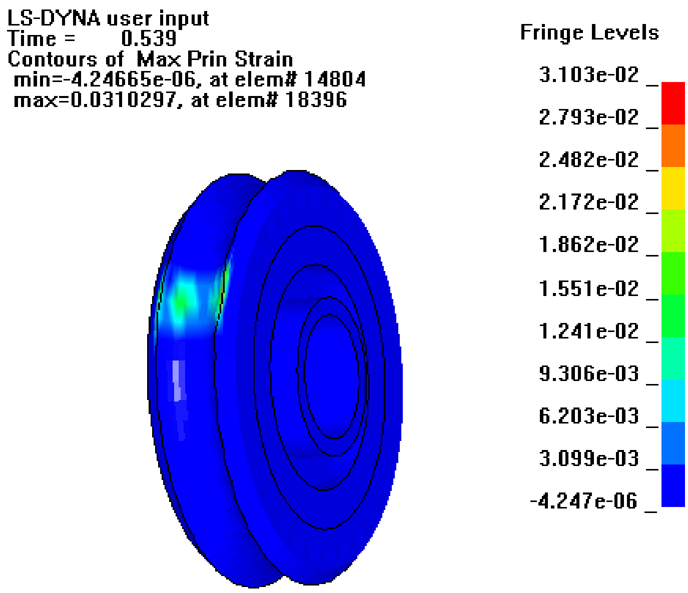


Fig.8 The max prin strain of roller in the process of rolling

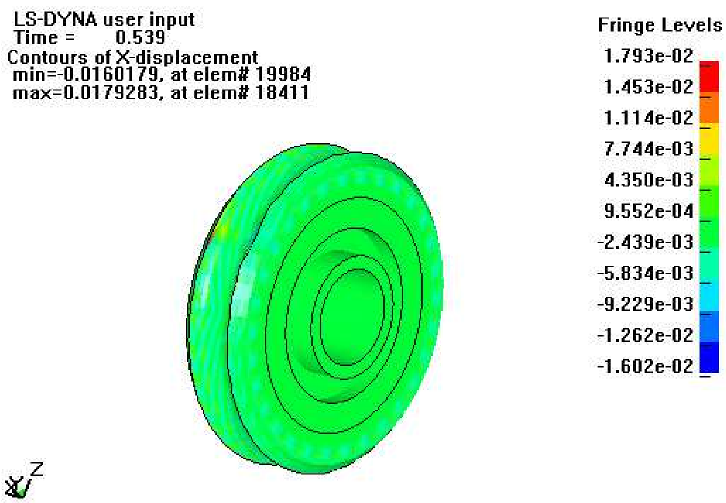


Fig.9 The displacement distribution along X-direction in the process of rolling

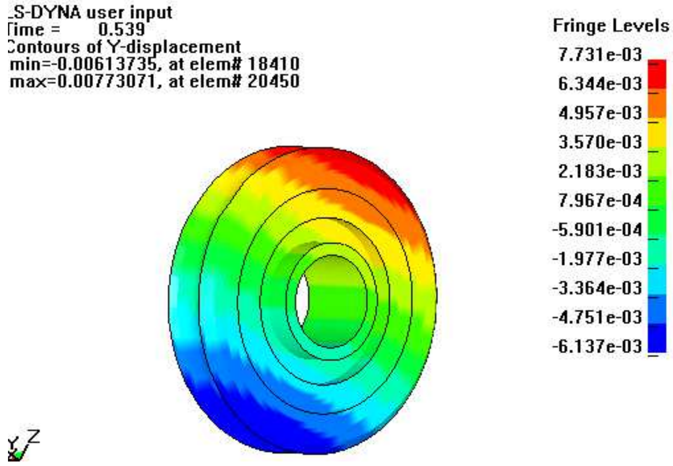


Fig.10 The displacement distribution along Y-direction in the process of rolling

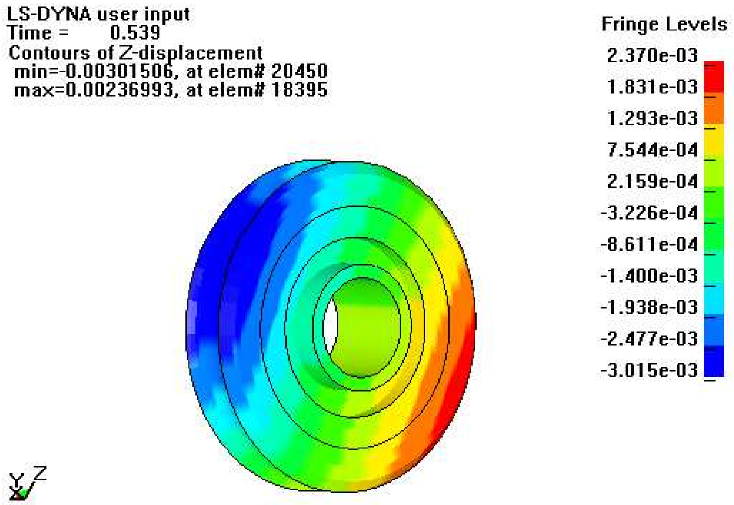


Fig.11 The displacement distribution along Z-direction in the process of rolling

Conclusion

It can be seen from Fig.7, the maximumVon-Mises stress is 125MPa, and it is less than that of allowable stress 160 Mpa. It can be seen from Fig.8, the maximum strain is 0.018. It is can be seen from Fig.9, Fig.10, and Fig.11, X-direction displacement, Y-direction displacement and Y-direction displacement is respectively within the allowable change range(0.001~0.035), this can reflect the rolling condition.

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