

<https://doi.org/10.26160/2572-4347-2020-11-43-47>

SHEET METAL BENDING PLASTIC DEFORMATION SIMULATION USING COMPUTER AIDED DESIGN SYSTEM

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Keywords: bending simulation, sheet metal deformation, computer-aided design system.

Abstract. Currently engineers use computer-aided design tools to simulate processes and systems. This allows to reduce time and material costs and improve design quality. The article presents bending process simulation results using CAD Siemens NX.

МОДЕЛИРОВАНИЕ ПЛАСТИЧЕСКОЙ ДЕФОРМАЦИИ ЛИСТОВОЙ ЗАГОТОВКИ В ПРОЦЕССЕ ГИБКИ С ИСПОЛЬЗОВАНИЕМ СРЕДСТВ АВТОМАТИЗИРОВАННОГО ПРОЕКТИРОВАНИЯ

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Ключевые слова: моделирование процесса гибки, деформация листовой заготовки, система автоматизированного проектирования.

Аннотация. В настоящее время инженеры используют средства автоматизированного проектирования для моделирования процессов и систем. Это позволяет сократить временные и материальные затраты и повысить качество проектирования. В статье приведены результаты моделирования процесса гибки с использованием САПР Siemens NX.

One of the modern industry requirements is low-waste production technology using. So using of various types of material processing treatment (OMT) is very effective in production. OMT is widely used in many areas of industry, such as: mechanical engineering, aircraft construction, shipbuilding, car building, and many others [1]. Depending on the type of production, material, reliability, shape and size of products, pressure processing is divided into rolling, bending, pressing, drawing, forging, stamping [2].

The main purpose of the work is bending process simulation and sheet metal deformation model development. It is used in roll forming production to analyze static and dynamic processes occurring during plastic material deformation.

Simple model of sheet bending machine is built according to the hydraulic three-roll machine W11.AA25.90x3000 dimensions. The machine is intended to bend a sheet up to 3000 mm wide. It is designed for bending metal sheets into cylindrical, conical and other structures.

Geometric models of rolling sheet and bending machine which includes the presser and support rolls were designed in Modeling Siemens NX application.

The resulting assembly is a master-model. It designed to support parallel development in the NX applications. Application data is associated with the geometry of the master-model i.e. when the master-model is changed all details are update automatically [3].

For engineering analysis based on the finite element method (FEM) the NX Advanced Simulation application was used. All applications are represented in NX integrated uniform environment [4]. Using specialized tools Modeling application allows to adapt the CAD geometry design to perform finite element analysis. It includes a wide range of tools for pre-and post-processing models and supports basic solvers for multiphysical calculations [5].

The main steps of the work to prepare and simulate three-roll sheet bending machine are the following.

1. Preparing a geometric model of parts and assemblies.
2. Idealized assembly model design.
3. Discrete model design.
4. Material assignment.
5. Setup solution options and execution of the selected analysis type.
6. View and analyze results.

During hydraulic three-roll machine model development and research three experiments were performed.

1. Only the upper roll is pressed down relative to the Y-axis and the lower rolls are rotated clockwise around the X-axis (Fig. 1). The obtained nonlinear and plastic deformations are shown in Fig. 2.

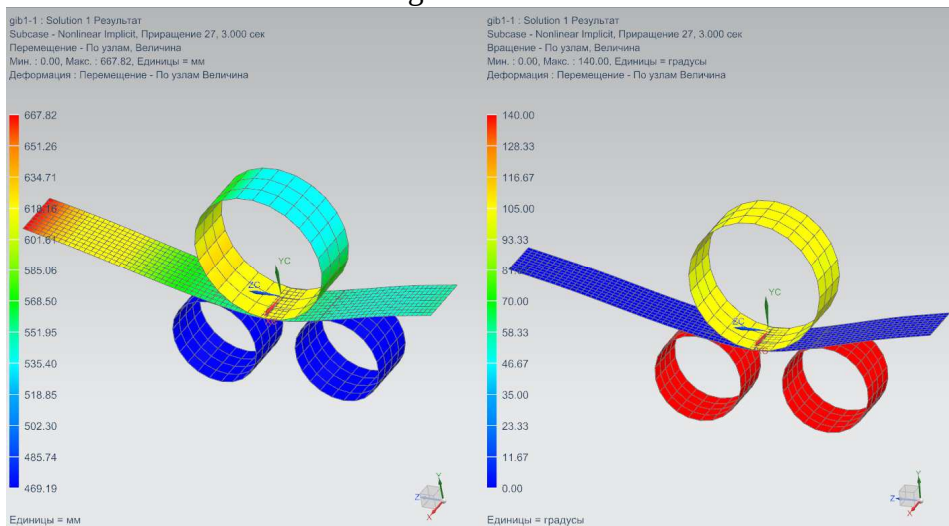


Fig. 2. Moving and rotating through nodes for $t = 3$ s

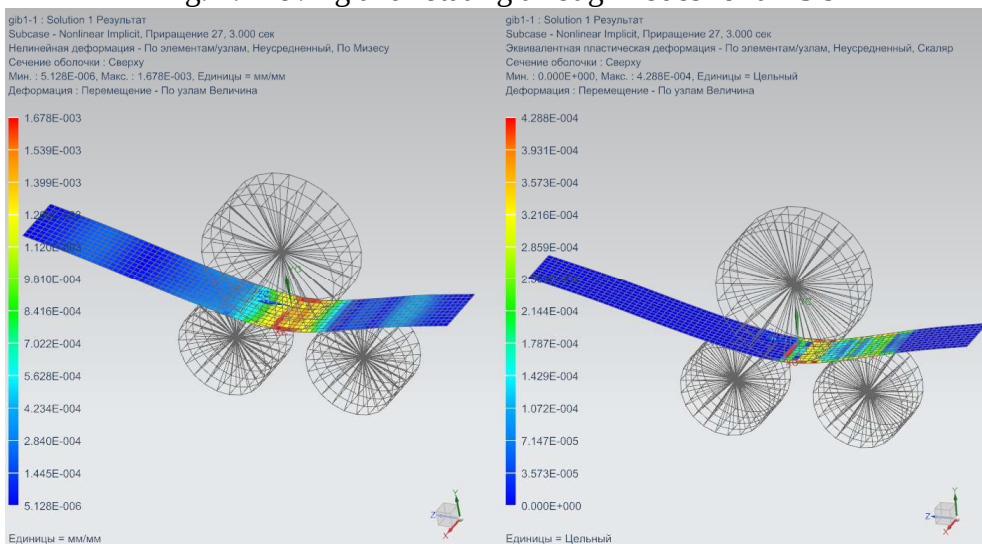


Fig. 2. Nonlinear and plastic deformations for $t = 3$ s

2. The upper roll is pressed down relative to the Y axis, the lower right roll is pressed up relative to the Y axis and the lower rolls are rotated clockwise around the X axis. The obtained nonlinear and plastic deformations are shown in Fig. 3.

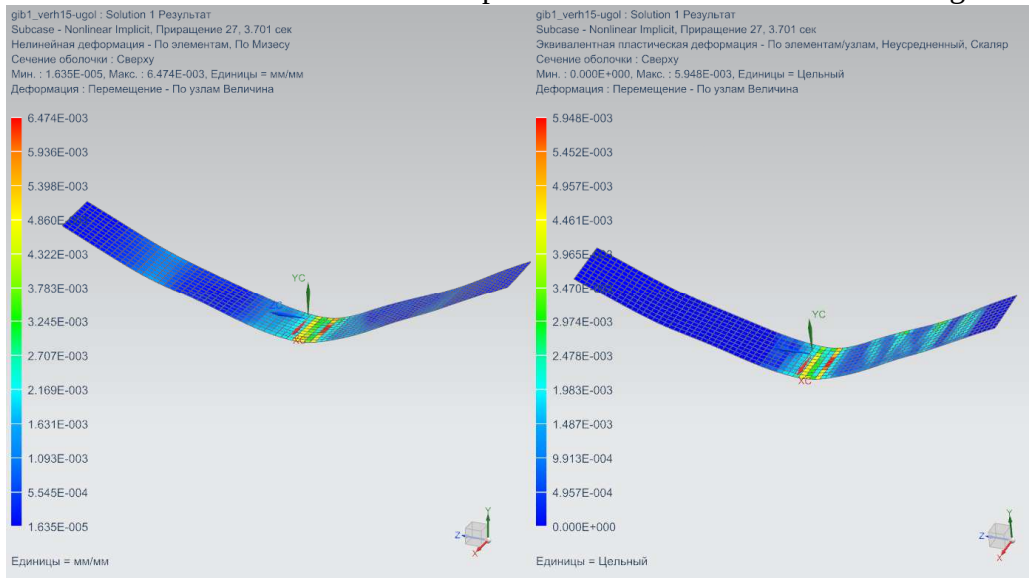


Fig. 3. Nonlinear and plastic deformations for $t = 3.7$ s

3. It is taken into account for upper roll pressing down relative to the Y axis the bottom right of the roll up relative to the Y axis rotation of the lower rolls about the X axis clockwise the left lower pressure roll upward relative to the Y axis and rotation of the lower rolls about the X-axis counterclockwise. In the last experiment the reverse movement of the sheet part is modeled (Fig. 4). The resulting nonlinear and plastic deformations are shown in Fig. 5.

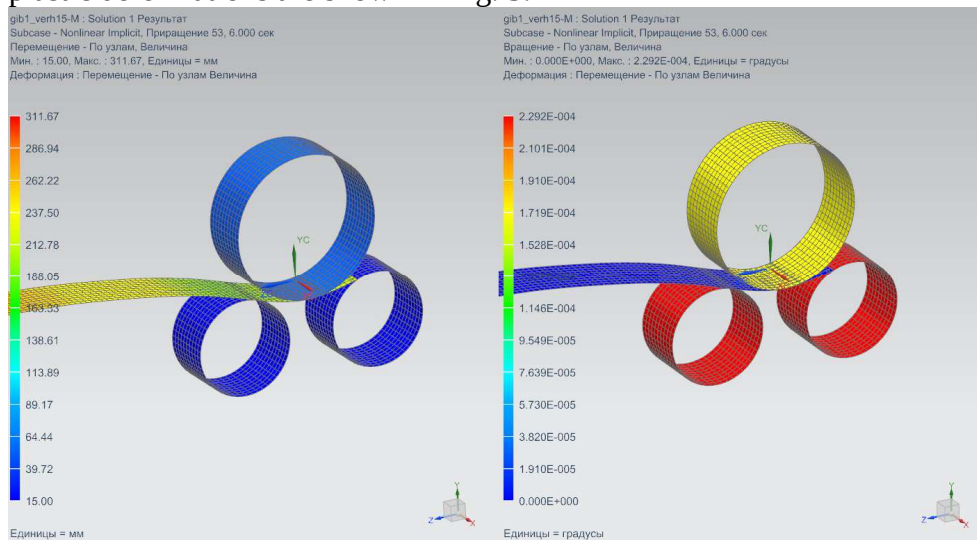


Fig. 4. The displacement and rotation at the nodes for $t = 6$

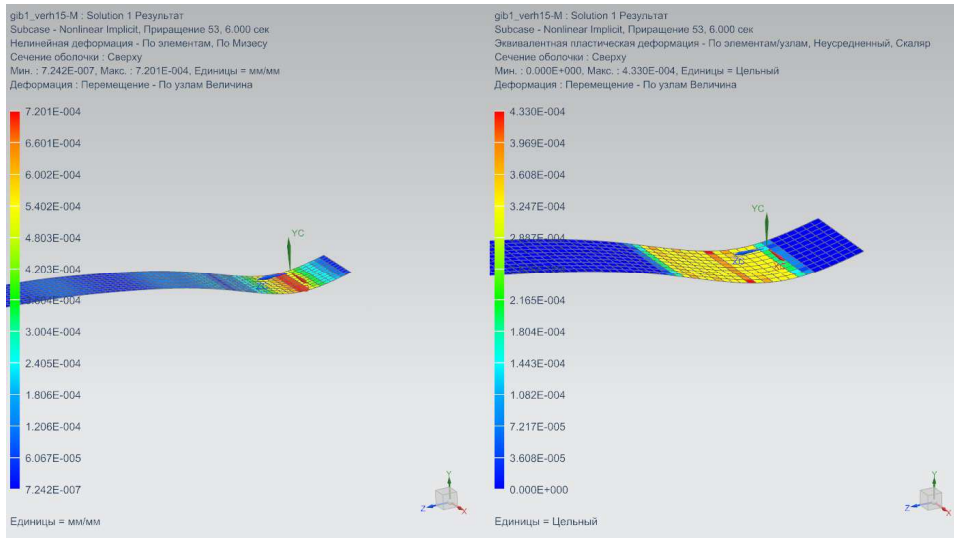


Fig. 5. Nonlinear and plastic deformations for $t = 6$ s

The experiments demonstrated that sheet part behavior was revealed at different positions of the right edge of the part relative to the lower right roll. If the edge did not reach the line of intersection of the YOX plane with the right roll then "chewing" of the sheet part was observed. Therefore the part should be placed with a certain offset relative to this line (Fig. 6).

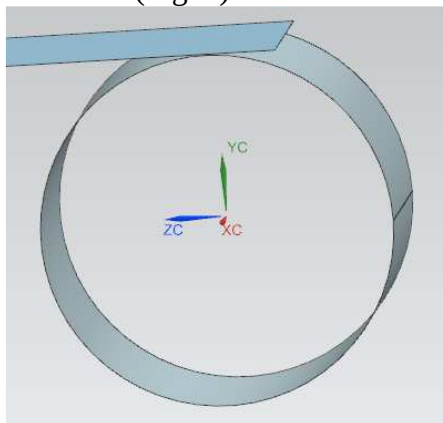


Fig. 6. Sheet part location relative to the lower right roll

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Received 01.11.2020