Design and Fabrication of Metal Sheet Clamping for Stamping Operation

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ABSTRACT

Mathematical and computer modelling have been playing an increasingly important role in the Computer Aided Engineering (CAE) process of many products. Simulation offers great advantages in the development and analysis phase of products and offers a faster, better and more cost effective way than using physical prototypes alone.
In this paper the special tool design for clamping and stamping at same place for proper gripping of the sheet metal. The design of this special tool is develop in the creo 5.0. The proper gripping of the sheet metal under these tool minimize the wrinkles appear on the sheet metal during punching operation. The ANSYS software is used to find out the stresses develop on the springs during the application of load. For the analysis we are considering internal contact with the upper block plate, the stress distribution and deformation are obtained. Taking the single spring as an example, comparison between the performance of the upper block and the steel spring is presented. The comparison results show that the composite spring has lower stresses and much lower weight.

Keyword: - *Creo 5.0 Clamping, Stamping, sheet metal, punching machine, spring, Ansys*

1. INTRODUCTION

Stamping is defined as an operation in which a flat sheet metal is placed on die and punch to impress a desire shape using ma punch. A clamp is a fastening device used to hold or secure objects tightly together to prevent movement or separation through the application of inward pressure. There are many types of clamps available for many different purposes. Some are temporary, as used to position components while fixing them together, others are intended to be permanent. In this project we design and develop the tool which perform the both operation at same place for better holding the plate. The proper holding is required on the tool to avoid the wrinkles appear on the sheet metal which is our final product. The corners are bend during the punching operation because of this the scrape generation is maximum. To overcome this problem we design the holding tool in creo 5.0 and done the analysis on ANSYS software for considering the single spring.

2. Problem Identification

The case study is perform at Opel Sheet metal pvt ltd. The company made component of sheet metal with the punching press. The blank is of 960X250 having thickness of 10 mm. The problem occurs during the punching is that, the plate get bend at the corners as well as the wrinkles are form on the sheet. The scrap is get increase when the no. of plates are less. To minimize these scrap as well as formation of wrinkles we are design the holding tool. This holding tool has two blocks as shown below in figure 1(a).
1) Upper block where the load is applied as shown below in figure 1(b) and
2) Lower block where the end of the spring located it also give support to the back side of sheet metal during punching as shown below in figure 1(b).

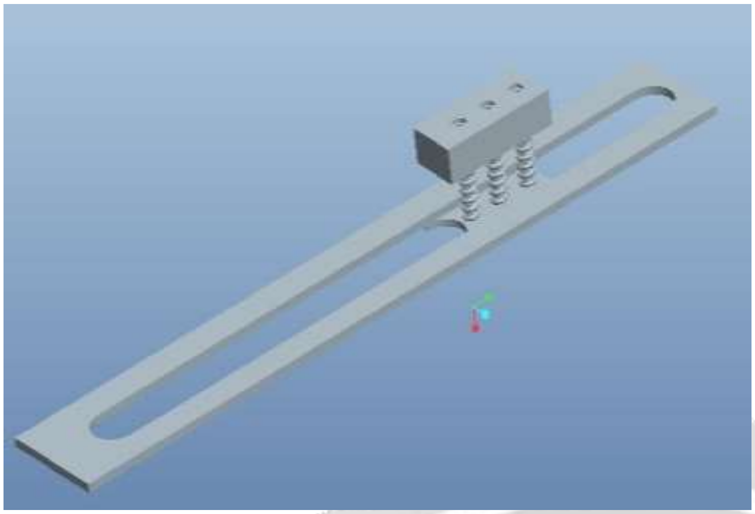

Fig.1 (a). Holding Tool with Sheet Metal

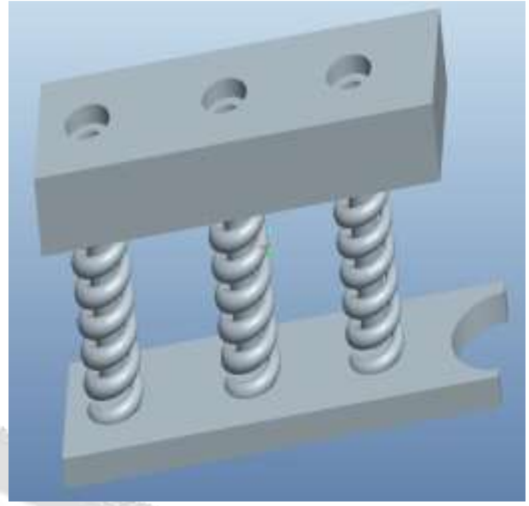

Fig.1 (b). Holding Tool

3. MATERIAL PROPERTIES

The selection of material is govern by the market demand and customer requirement. In our project the product is use in hospital bed, drawers and Almira, It is necessary to use the cold rolled steel. The material properties of cold roll is given below

1. Chemical Composition of Sheet Metal

Element	C	Si	S	P	Mn
%	0.015	3	0.003	0.006	0.15

Table 1 Chemical Composition of Sheet Metal

2. Mechanical Properties of Sheet Metal

Sr. No.	Properties	Values	SI unit
1	**Density**	**7600**	**Kg/m^3**
2	**Young's Modulus**	**200**	**GPa**
3	**Poisson Ratio**	**0.330**	**-**
4	**Hardness**	**37**	**BHN**
5	**Yield Strength**	**427**	**MPa**
6	**Ultimate Strength**	**400**	**MPa**
7	**Shear strength**	**128**	**MPa**
8	**Thermal conductivity**	**89**	**W/m-k**
9	**Thermal Expansion**	**12.4**	**/K**
10	**Melting Point**	**640**	**^{0}C**
11	**Specific Heat**	**481**	**J/Kg-k**

Table 2 Mechanical Properties of Sheet Metal

3. Chemical Composition of Tool

Element	C	Cr	Co	Mo	V
%	1.5	12	3	1	0.25

Table 3 Chemical Composition of Tool

4. Mechanical Properties of Tool

Sr. No.	Properties	Values	SI unit
1	**Density**	**7700**	**Kg/m^3**
2	**Young's Modulus**	**190**	**GPa**
3	**Poisson Ratio**	**0.33**	**-**
4	**Hardness**	**769**	**BHN**
5	**Yield Strength**	**410**	**MPa**
6	**Ultimate Strength**	**483**	**MPa**
7	**Shear strength**	**128**	**MPa**
8	**Thermal conductivity**	**155**	**W/m-k**
9	**Thermal Expansion**	**$22.8x10^{-6}$**	**/K**
10	**Melting Point**	**640**	**^0C**
11	**Specific Heat**	**880**	**J/Kg-k**

Table 4 Mechanical Properties of Tool

4. DESIGN AND ANALYSIS

4.1 Design of Tool

Tool is designed by using CREO 5.0 as per the specifications and analyzed by ANSYS 12.0software. In this the spring behavior will be observed by applying different materials loads, to optimum stresses and the result shows best material. Model of the spring will be first created by using PRO-E. Following is the figure after meshing in the ANSYS 12.0. A model of the helical spring was created using Pro/Engineer software. Then the model will be imported to analysis using FEA uses a complex system of points called nodes which make a grid called a mesh. This mesh is programmed to contain the material and structural properties which define how the structure will react to certain loading conditions. Nodes are assigned at a certain density throughout the material depending on the anticipated stress levels of a particular area. This model includes static analysis with different materials to optimum the stresses.

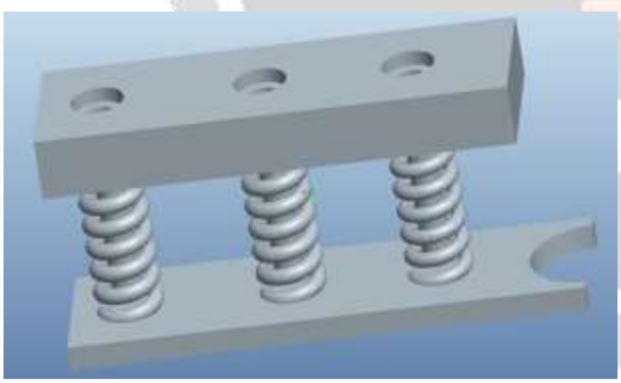

Fig. 2 Design of Tool by using CREO 5.0

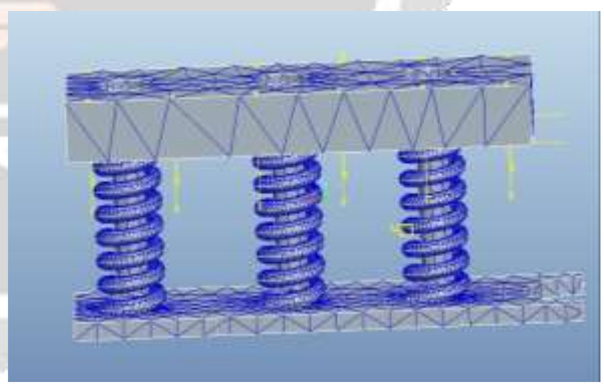

Fig. 3 Design of Tool by using ANSYS

4.2 Design of spring

After selection of material, we have tested this material by using previously suggested designs at the working load of 12 Ton. Initially we are testing this material by analytical method some important notifications.

1. Deflection $$\delta = \frac{64\, W R^3 n \, Sec\,\alpha}{d^4}\left(\frac{\cos^2\alpha}{C}+\frac{2\,\sin^2\alpha}{E}\right)$$

2. Bending Stress $\sigma_b = \frac{32\ W\ R\ Sin\alpha}{\pi d^3}\ \mathrm{N/mm^2}$

3. Shear Stress $\tau = \frac{16\ W\ R\ Cos\,\alpha}{d^4}\ \mathrm{N/mm^2}$

4. Stiffness $K = \frac{E}{\delta}\ \mathrm{N/mm^2}$

5. For Parallel Spring F = F_1+F ; $\delta K = \delta_{12}K_1+\delta$;
But, $\delta = \delta_{12} = \delta$
Therefore, K = K_1+K

Where, N is the number of active turns and G is the shear modulus of elasticity. Now what is an active coil? The force F cannot just hang in space, it has to have some Material contact with the spring. Normally the same spring wire e will be given a shape of a hook to support the force F. The hook etc., although is a part of the spring, they do not contribute to the deflection of the spring. Apart from these coils, other coils which take part in imparting deflection to the spring are known as active coils.

Wire diameter = 20mm, Coil outer diameter=66 mm, Coil free height =210 mm, No. of active Coils =08, pitch =12 mm, and test load on each spring =4.000 N. In this paper we used the parallel spring orientation because individual spring does not sustain higher load. Because of the parallel combination, the total load is distributed into three so the total load acting on single spring is less. In this paper, we have tested designs of springs with and without combination and the result is compared. Result of load test on individual spring design.

Sr. No.	δ (mm)	τ (N/mm2)	K (N/mm)
1	89.33	489.18	30.11
2	2.6568	0.13049	10350.79
3	4.18	0.13049	6.56
4	7.6518	0.13049 N/m	35.93

Table 5 Results Obtain By Analytical Method

4.3 Static analysis:

Structural analysis consists of linear and nonlinear models. Linear models use simple parameters and assume that the material is not plastically deformed. Non-linear models consist of stressing the material past its elastic capabilities. The stresses in the material then vary with the amount of deformation as in it.

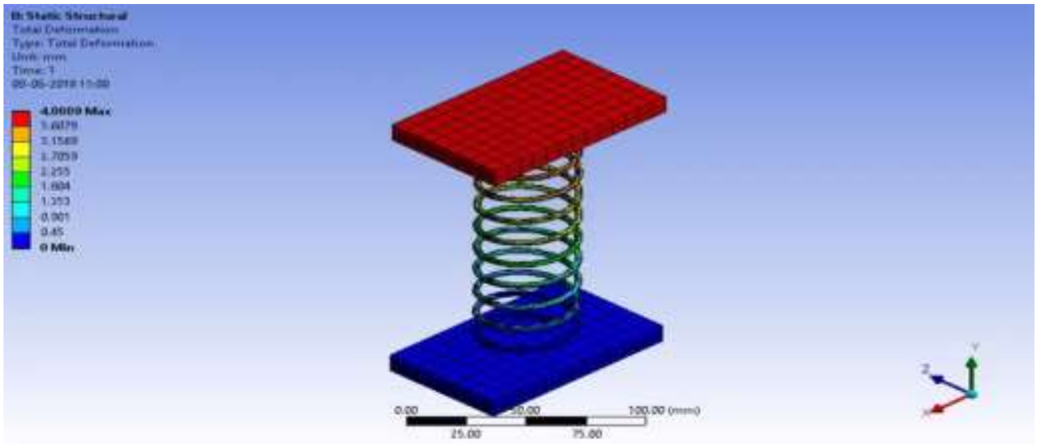

Fig. 4. Static Structure analysis

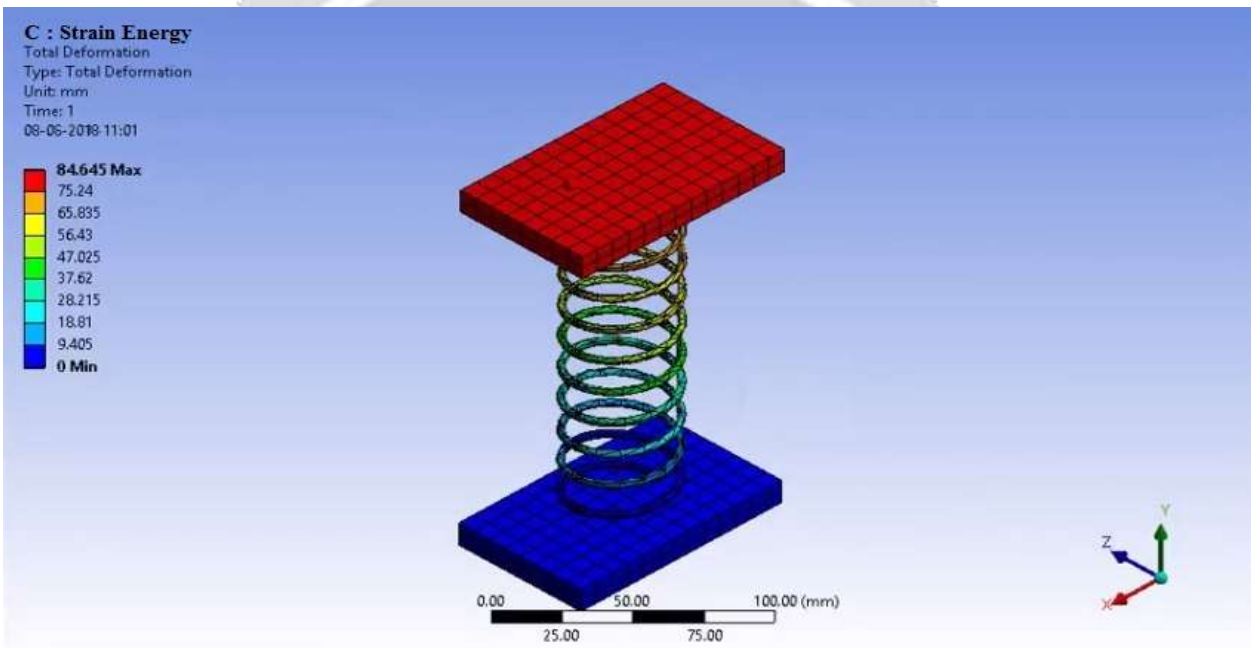

Fig. 5. Static Energy

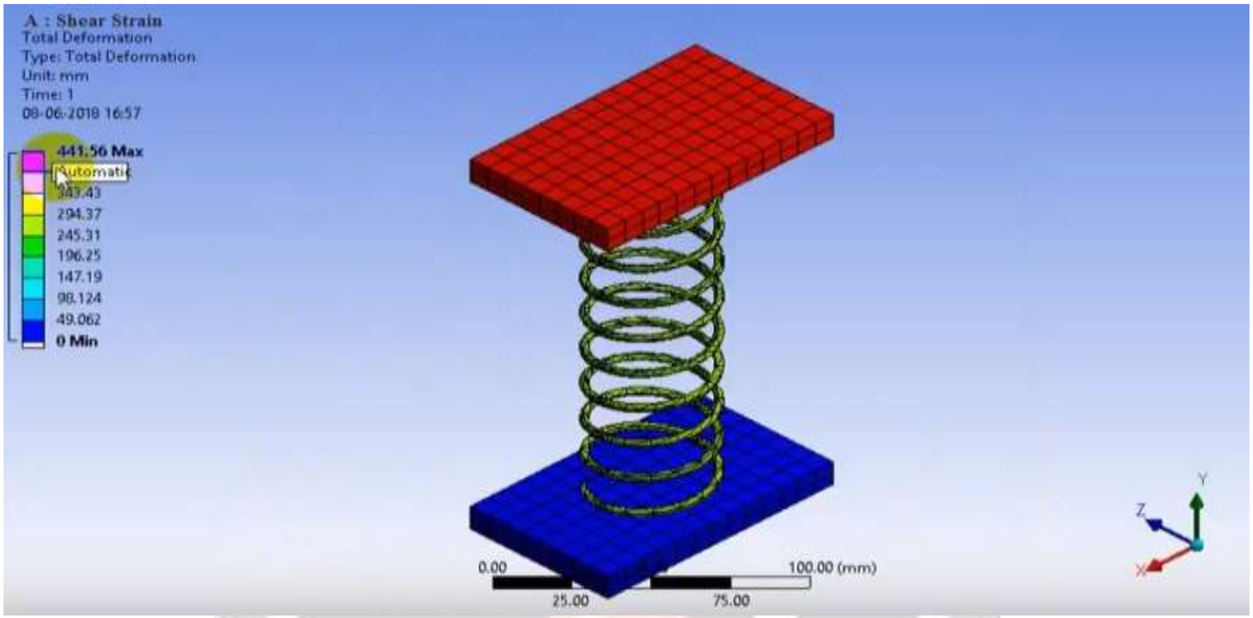

Fig. 6. Shear Strain

6. RESULTS AND DISCUSSION

In this chapter, analysis of helical coil spring by using the FEA (WORKBENCH) has been discussed. This analysis provides the results and under the loading condition, compression strength of helical coil spring is obtained. Stress distribution of helical coil spring is as shown below in figure In this case, static analysis is done by using the finite element method, in the figure blue color indicates the minimum stresses 49.062E6 acting on the turns and red color indicates maximum stresses 441.56E9.

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