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Study on Velocity Parameter for Roll Forming Process

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Abstract--- **The roll forming process works by passing sheet metal through a series of rollers, with each of these rollers adding shape to the metal. The rolls work together to form the desired cross section. Since the process is consistent and easy to repeat, roll forming provides a great way to precisely produce very high volumes of metal components. Experimental and numerical methods are studied in this paper.**

Index Terms— **Roll forming, Longitudinal strain, residual stress, Spring back effect, FEA**

I. INTRODUCTION

Roll forming is a proven method for metal shaping that is ideal for modern applications. This process uses a continuous bending operation where metal strips, coiled steel, are passed through sets of rollers. The roll forming process increases efficiency while reducing the cost by removing unnecessary handling and equipment. The bend radius determined by the ductility of the metal. Roll forming process removes some operations like welding, punching, Precision laser cutting to increase production efficiency. To remove velocity defects in the roll forming process, researches are done in experimental and numerical methods.

Paralikas, J., Salonitis, K. and Chryssolouris, G (1), researches roll forming parameter, they used DP600 for their studies. They studied that the velocity of the roll forming process can be adjusted. It mainly affects the strain value in material. Increasing in the velocity can bend material and form defects in material. And if we change the gap in between the rollers we can reduce this defect. The velocity of strip has an effect on this longitudinal strain by 5.41% and shear strains with 8.34%

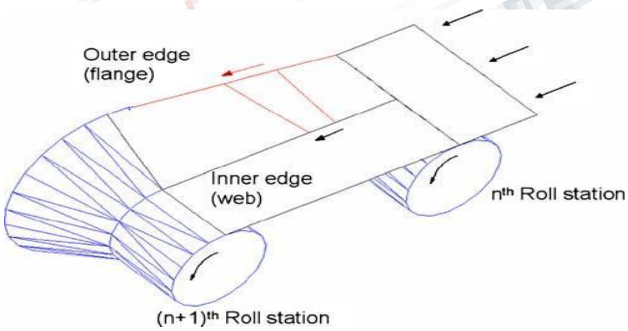

Fig.1 Outer edge travels greater distance than web through successive rollers

Park, H., Anh T. and Dang, X (2), researches on mechanical behaviour of aluminium sheets. In this paper they have used MATLAB software. This paper presented an application of the ANN-GA hybrid approach for modeling and optimizing the RF process of an aluminum car door belt. This result proved the capability and efficiency of the ANN-GA hybrid model in modeling the RF process of an aluminum car door belt. The data is processed from each layer of the network. Then the result is obtained on the output network. We study that when velocity is low, the spring back effect is more. But, the spring back angle decreases with increase in velocity.

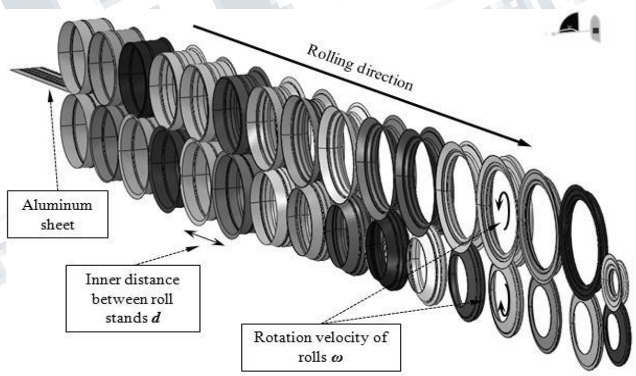

Fig.2 The simulation of the RF process of the car door belt of our experiment

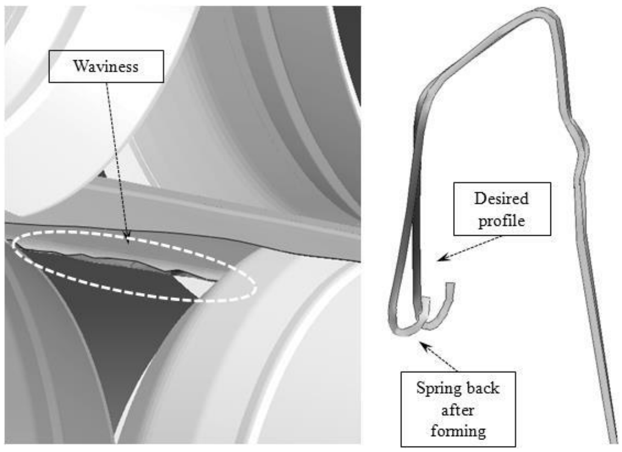

Fig.3 The simulation results of the defects in the aluminum sheet and the spring back phenomenon at the final pass

Paralikas, J., Salonitis, K. and Chryssolouris, G., (3), Research roll forming parameters, they used DP780 material for their studies. They studied that the calculated decrease in the peak longitudinal strains of up to 28%, and the decrease in thickness of up to 38% are also presented and discussed , the design of flower patterns includes the application of downhill pass flow and variable bending radius along the roll forming passes.

The results from the finite element analysis have shown reduction in the elastic longitudinal strains by about 28% on the V-section profiles and by about 6.36% on the U-section profiles with application of downhill pass flow technique on the flower pattern design.

Moreover, the reduction of thickness was improved for the cross sections under study, by 38%for the V-sections and by 13.81% for U-sections, with the application of the downhill pass flow. The spring back has shown that it remained unaffected from the application of the downhill pass flow.

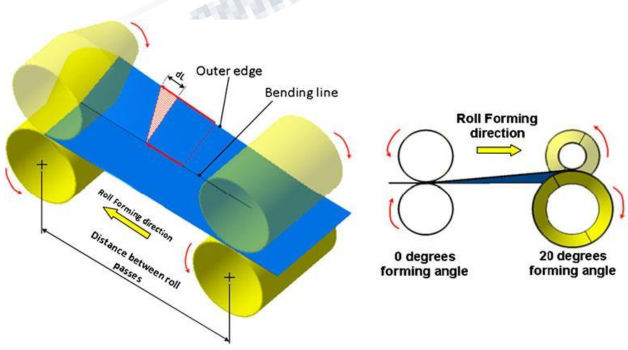

Fig.4 Outer edge travels greater distance than web through successive rollers

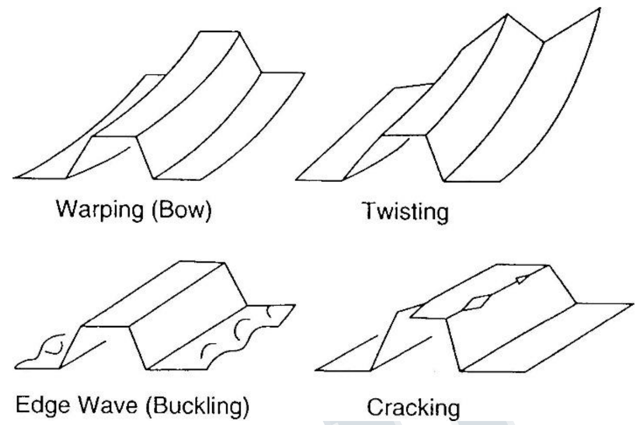

Fig.5 Main defects caused by redundant deformations on roll-formed products

Paralikas, J., Salonities, K. and Chryssolouris, G. (4), Research roll forming parameter, they used DP600-HDG for their studies. They compare the total longitudinal strains along the roll-forming direction. The line speed change mainly affects the residual longitudinal strains at edge, and at the distribution of the strains along the profile. Increasing the line speed will not primarily affect, but it will affect total residual strains in a longitudinal direction. The longitudinal strain occurs at the strip's edge. Due to longitudinal strain there can be defects like bow, camber and twist. The non-uniform distribution of strains is unavoidable during roll forming, but the magnitude of the peak could be reduced by reducing the line speed. The transversal strains before leads to extensive distortion at the folding line and loss of accuracy at the ends.

Safdarain, R. and Naeini, H.M., (5), investigated on cold roll forming of channel section, they used steel sheet St14 material. During this study the effect of some roll forming parameters of channel section are investigated on the sting longitudinal strain and bow defect of products. Longitudinal bow is one amongst the most defects within the cold roll forming products which is laid low with the bending angle increment. Results of present study show that peak of longitudinal strain within the fringe of the channel section increases with the bending angle increment and strip thickness increase, but decreases with the flange width, web width and distance between the roll stands increases. Results show that friction within the roll-strip contact and speed of roll stand doesn't have any effect on the sting longitudinal strain.

Ji-long,Y. ,Ying-bing ,L. ,Da-yong ,Li.,Ying-hong , P., (6), researches on continuous quasi static loading process, the dynamic explicit finite element (FE) method exhibits

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greater capability than other implicit methods in decreasing CPU time, saving memory and dealing with the contact. A key problem was noticed, when using dynamic explicit codes, is that the method is a conditional stability algorithm. When using virtual velocity for increasing the time, dynamic effects are the weakness. By choosing a series of control parameters for current damping models and loading velocity curves, the dynamic effects can be minimized to a reasonable level.

The simulation prevented hour glassing from becoming significant; the result is acceptable. The study has shown that the dynamic explicit finite element method can be used accurately to simulate the roll forming process under certain good parameter control and loading curve type selection. To realize the whole process simulation, we can cut the elements on the front of the strip and append them to the tail of the strip.

Sheikh, M.A. and Palavilayil,R.R. , (7), Studied that SHAPE is a FE based solution provider, which covers a wide range of roll forming and rotary forming simulations including tube spinning, flow forming, thread rolling and ring rolling . It shows powerful analysis tools for heat transfer, roll stress and microstructure analysis.

There are few areas where the software can be improved

• The simulation time is a bit longer.
• Rolls are considered rigid.
• Information about the stresses in the rolls and formed roll is not available.

Li,L.M., Li ,D.H.,Peng, Y.H., (8) studied that ABAQUS/Explicit as a user-defined element, through which the sheet metal forming processes are simulated. The main property of this FE model is that the solid shell element formulation is embedded into an explicit finite element procedure and compared to the previous studies on the solid-shell elements under the implicit FE framework. To obtain a straight forward element, a complete integration scheme is adopted. No loss of generality is noticed. Twelve parameters are assumed in the strain method, employed to improve the element's behavior. U-channel roll-forming process is simulated with this explicit solid-shell FE model. The combination of the solid-shell element and explicit FE integration method are proven to be effective in the simulation of sheet metal forming processes.

Cho,J.,Kim,H.,Lee,M., Cho,K., And Joun,M., (9) In this study, they performed three-dimensional finite element simulations of the entire process of straight stringer manufacturing used for aircraft structures. A finite element simulation of a roll forming sequence for aircraft was performed in this study. A rigid–plastic finite element method was employed and an unsteady approach was used to reveal the detailed metal flow behavior between the roll stands. The free nodal points on the plane of symmetry or in the roll bite region were considered as velocity-prescribed boundaries while the roll– material interface was modeled using the constant shear friction law. The proposed approach was applied successfully to the roll forming process for a straight stringer used in aircraft structures.

Bui,Q.V., Ponthot,J.P., (10) Studied that it is the friction force at sheet-roll interfaces that forces the advance of the metal sheet in the roll-forming direction in this dynamic analysis. The sheet advancement was obtained through an imposed displacement at the plane of symmetry of the sheet in the static analysis. such as constant velocity at the sheet front end constant velocity at sheet-roll interface. Ultimately, Sheu has recently carried out a simulation, where the front end of the sheet was fixed and the tools were moved towards the sheet with a set speed. Therefore, it appears that the way the sheet is advanced through the rolls, it's unlikely to be important for the simulation result as far as the speed of the sheet remains adequate.

Park, H.S. and Anh, T.V., (11), In this paper, many RF processes of different automotive components have been simulated and analyzed by the general and the specific analysis. The characteristics of each method and differences between them are clarified. With a application in designing, the design procedure using a combination of different analysis methods obtained the optimum process with 41% less time for running, less cost for producing a prototype than the previous procedure. The further plan of This research is to apply the combination of different analysis methods to the design of flower diagrams and optimization of number of passes. It provides the more reliable and optimum solution than empirical method at present.

Jan,F., and Onipede,O., (12) studied that when the front end of the sheet reaches the second set of rollers, the bottom roller is moved up to meet the panel and the contact function is turned on. As the rear end of the sheet metal leaves the second set of rollers, the contact function will be turned off and the bottom roller will go back to the original position. In the roll forming process the rotations of upper and bottom rollers are different. In this paper it was shown that using smaller rollers, which were placed closer might produce a panel with fewer defects.

II. CONCLUSION

The results from the finite element analysis have shown reduction in the elastic longitudinal strains by about 28%

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on the V-section profiles and by about 6.36% on the U-section profiles with application of downhill pass flow technique on the flower pattern design. They compare the total longitudinal strains along the roll-forming direction. The line speed variation mainly affects the distribution of the strains along the profile, as well as residual longitudinal strains at edge.

Increasing the line speed will not primarily affect the peaks, but the total residual strains in a longitudinal direction. The maximum longitudinal strain occurs at the edge of strip's. Due to longitudinal strain there can be defects like bow, camber and twist. The non-uniform distribution of strains is unavoidable during roll forming, but it can be reduced by reducing the line speed.

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