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Development of The Multi Forming Type Ultra Precision Die for Sheet Metal (Part I)
- Production Part and Strip Process Layout -

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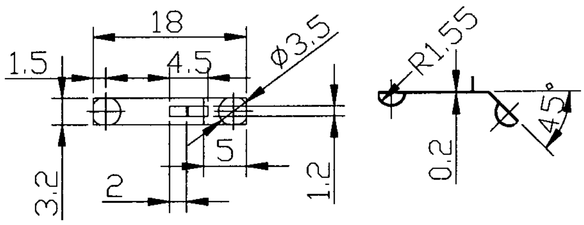
Abstract : This study reveals the sheet metal working with multi-forming type ultra precision process. They require analysis of many kinds of important factors, i.e. theory and practice of metal press working and its phenomena, die structure, machining condition for die making, die material, heat treatment of die components, know-how and so on. In this study, we designed and constructed a multi-forming ultra precision progressive die as a bending and drawing working of multi-stage and performed through the try out for thin sheet metal. This part I of papers related to the analysis of production part and strip process layout design through the metal forming simulation by DEFORM and IDEAS.

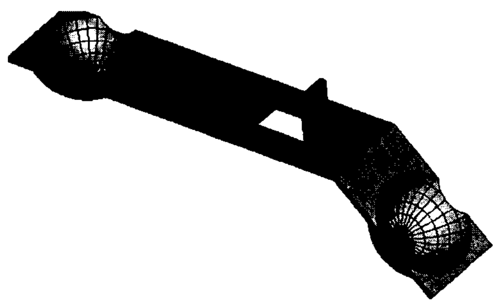
KEY WORDS : Production part, Web size, Strip process layout, Multi forming type progressive die

1. Introduction

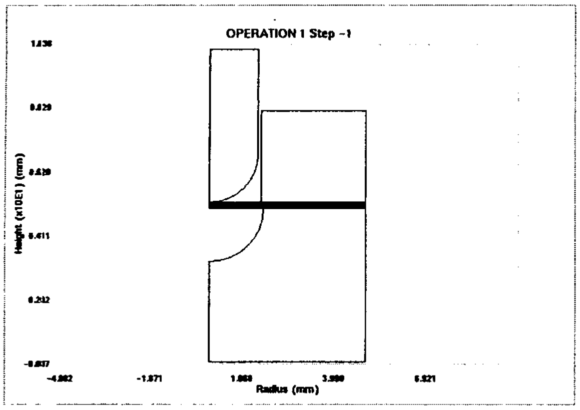
The multi forming type progressive die with multi-stage performs a series of sheet metal working at two or more stages during each press stroke to produce a piece part as the material strip moves through the die tunnel with a front and back gage. Press working for the optimum die design and its making has been become the purpose of industry by strip process layout with multi-stages.[1,2)]
We used the part of precision production part(Fig.1) in industrial production line.
So, this study needs a whole of press tool data, our field experiences, theoretical instructions, and ultra precision machine tool and its skillful operating and applications.
The add process of this work was performed FEM analysis by DEFORM and IDEAS. The result of this FEM analysis was very exactly that the output come to the figure ③,④ among ①~⑥ in Fig.1(c) through the side of velocity and load-time in Fig. 1(c) ⑦, ⑧.
So we considered that the production working of embossing by one time operation.
According to upper knowledge, this study could approach to the optimum die design for the least defect of production part.



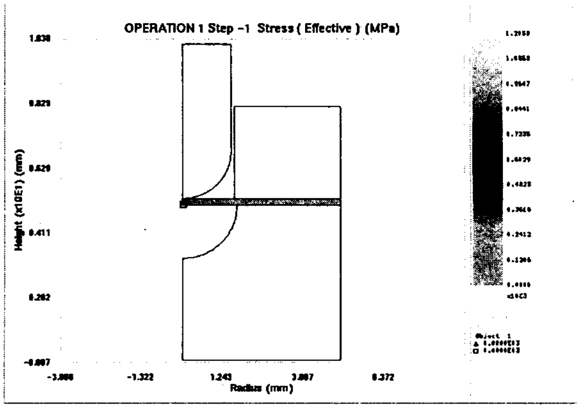
t : 0.2mm material : SUS304
(a) Production part drawing



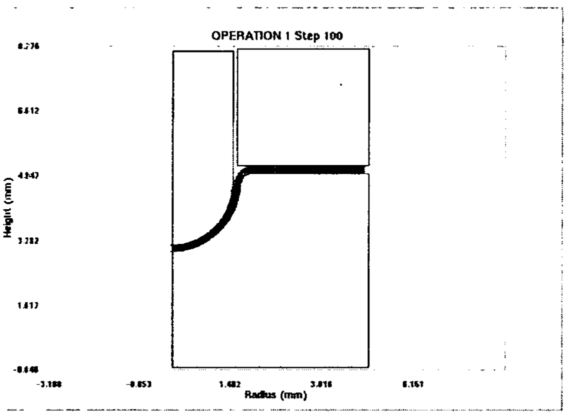
(b) Modelling of production part by IDEAS



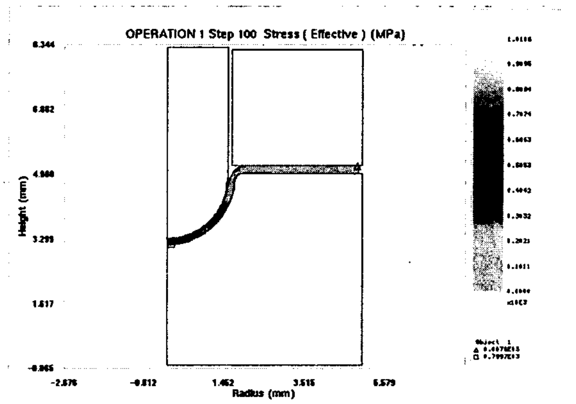
① Mesh system before deformation



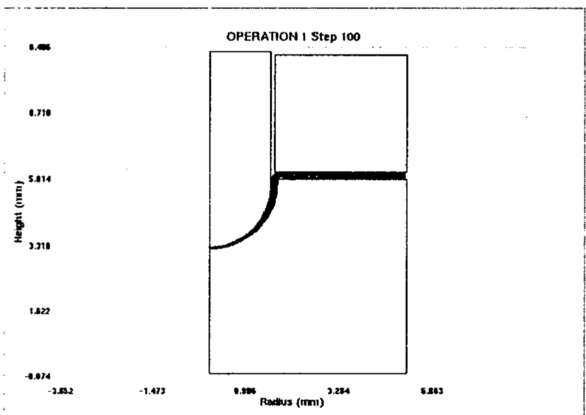
② Distribution of stress in the strip before deformation



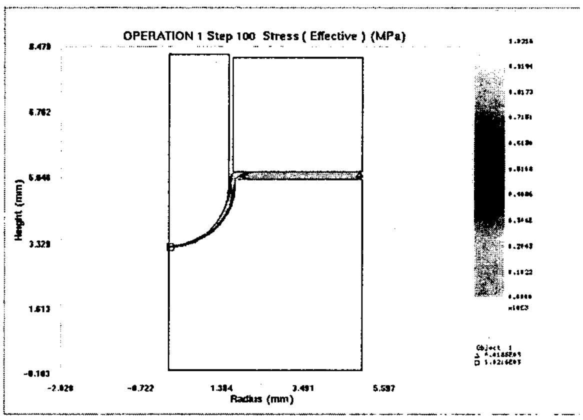
③ Mesh system after deformation



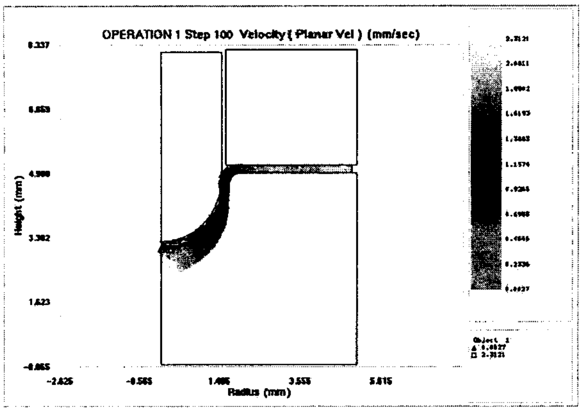
④ Distribution of stress in the strip after deformation



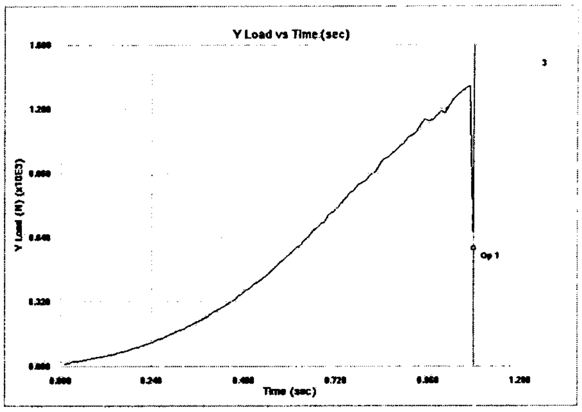
⑤ Mesh system when the problem of deformation



⑥ Distribution of stress in the strip when the problem of deformation



⑦ **Velocity**



⑧ **Load-Time graph**

(c) FEM analysis result

Fig 1. Production part drawing and its analysis by IDEAS and DEFORM

2. Strip Process Layout

The disposition of part on strip feed unfolding is the display with constant area repeatedly. Due to upper cause, it must be enough that the decision of part feeding distance (advance, pitch) and disposition of part on the strip lay out must be peformed exactly.

Tool designer's intention must consider that the best utilization ratio can be found the top of part arrangement.

This is the optimum method of initial die design.[1~5]

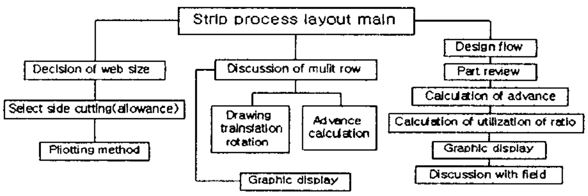


Fig.2 Flow chart of strip process layout design system

At this time we must refer the web size on the strip from database and experience too.

Fig. 2 shows the strip process layout design system. For the design of strip process layout, the first step is how to decide the feeding method which is according to the lot size of production part, material properties, and material thickness, the second step is same with a such as flow chart of Fig. 2

Assume a straight forward single-pass layout as shown in Fig 3(a).

Before the material requirements can be calculated, the value of a and b must be determined.

If the thickness of the material is less than 0.6mm the value of a and b maybe taken from Table. 1.

For the double-pass layout Table. 2 related Fig. 3(b) should be used when the thickness of the material is less than 0.6mm.

The number of blanks which can be produced from one length of stock is given by

$$N = \frac{L - b}{s} \qquad (1)$$

Where, L = length of stock

N = number of blanks

Table. 1

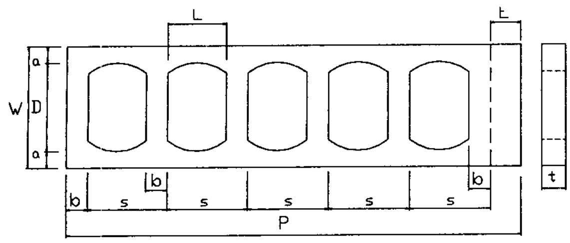
Web size in the case of Single-Pass Where t<0.6

Strip with, W in.	Dimensions a and b
0 - 3	0.8
3 - 6	1.6
6 - 12	2.4
over 12	3.2

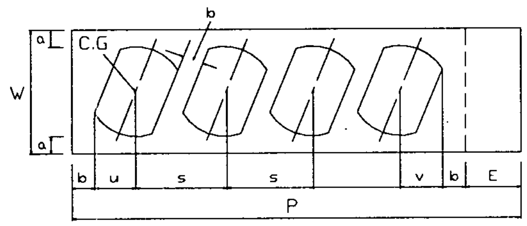
Table. 2

Web size in the case of Double-Pass Where t<0.6

Strip with, W in.	Dimensions a and b
0 - 3	1.6
3 - 6	2.4
6 - 12	3.2
over 12	4.0



(a)



(b)

Fig. 3 Web size in the case of Single and Double Pass where t<0.6

From the strip process layout designing method, the following strip process layout(see Fig.4) was designed the production part drawing. For the strip process layout it was considered that the proper sizes are strip width, web size, advance, side cutting allowance etc.(see Fig.3 and Table. 1, 2). The first stage performs piecing, the second stage works idle, third stage works piercing, fourth stage works idle, fifth stage performs slitting, sixth stage works 90° bending, seventh stage works embossing, eighth stage works 45° bending, and the last of ninth stage works parting.

3. Conclusion

Due to prevent the defect in die design, this study performed a analysis of production part design and strip process layout design through the IDEAS and DEFORM application method.

The result are as follows.

(1) Before the strip process layout design, it was very effective that the analysis of production part design by IDEAS and DEFORM application.

(2) Before the strip process layout design, We considered whole of data-base for the best design to the die development.

(3) The result of strip process layout design was very adaptive and practical working through the theoretical background and our enough experiences.

Acknowledgement

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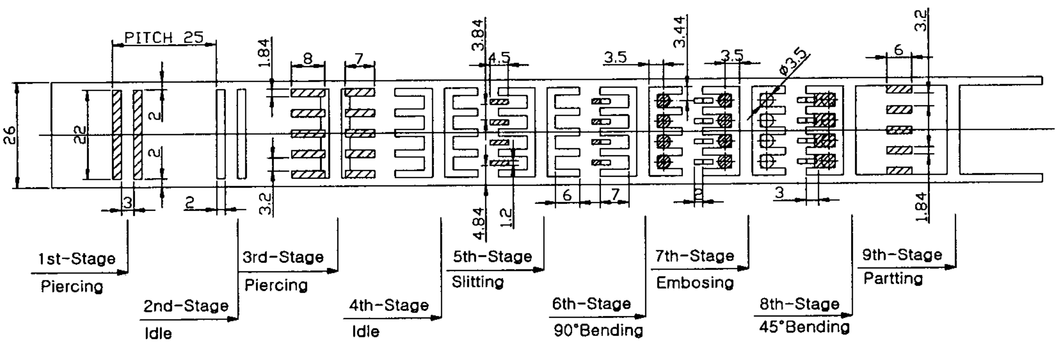

(a) Strip process layout

(b) The modelling result of strip process layout by IDEAS

Fig. 4 Strip process layout

References

(1) Sim, Sung-Bo, Park, Sun-Kyu, May(1999), Development of the Practical and Adaptive Die for Sheet Metals(1), Proceedings of KCORE Conference, pp. 141~148.

(2) Sim, Sung-Bo, Song, Young-Seok, May,(1999) Development of the Practical and Adaptive Die for Sheet Metals(2), Proceeding of KCORE Conference, pp. 149~155.

(3) herman, W. Pollack(1976) Tool Design, Prentice Hall co.

(4) Karl, a.Keys,(1982) Innovation in Die Design, SME, pp. 71~99.

(5) Hutota, M., (1975) Preworking and Die Making, Higan Tech. Paper Co., pp. 121~180.

(6) Hutota. T,(1969) Databook of Pressworking Process Design, Press Tech, Vol. 7 No. 13, Higan Tech. Paper Co., pp. 1~201.

(7) Donald, F. Eary, Edward, A. Reed, (1982), Techniques of Pressworking sheet Metal, Prentice Hall, Inc, Tool and Die Failures, ASM, pp. 18~31.

(8) Sung-Bo Sim, Young-Seok Song,(1999), Development for Practical and Adaptive Progressive Die for Design and Making of Marine Part Sheet Metals(1), Inter. Jour. of Ocean Eng. and Tech., KCORE, Vol. 2 No. 2, pp. 19~25.

(9) M. I. Moto,(1969), Press-Progressive Die Higan Industrical Paper Co.

(10) M. H. Moto,(1970), Press working and Die Making, Higan, Industrial Paper Co.