

## Development of the Practical and Adaptive Die of Piloting Stripper Type for Sheet Metal (part 2)

Sung-Bo Sim\*, Yu-Min Sung\*\*, Young-Seok Song\*\*\*, Hae-Kyoung Choi\*\*\*\*

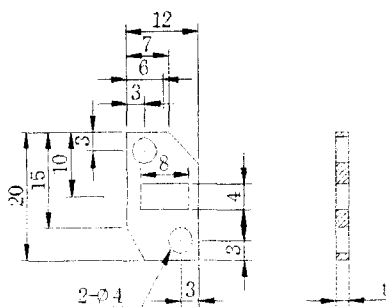
\* Pukyong Nat. Univ. School of Mech. Eng.  
 \*\* Pukyong Nat. Univ. Industrial Grad. School  
 \*\*\* Pukyong Nat. Univ. Grad. School  
 \*\*\*\* Pukyong Nat. Univ.

**Key Words :** Pitch, Piloting, FEM(Finite Element Method), Tryout

**Abstract :** In order to keep the zero defect of production in press working process, the optimum design of the production part, strip process layout, die design, die making and try out etc. are necessary the analysis of effective factors. For example, theory and practice of metal shearing process and it's phenomena, die structure, machine tool working for die making, die materials and it's heat treatment, metal working in field, their know how etc. are included in those factors. In this study, we analyzed whole of data base, theoretical back ground of metal working process, and then performed the progressive die tryout with the screw press. Part2 of this study reveals with precision progressive die design, its making and tryout.

### 1. Introduction

The type of this paper used part of products is shown in Fig. 1 from ordinary production part in industrial production line. Therefore, this study needs whole of press tool data, field experiences, and theoretical background. According to upper instructions, this study could be obtained approaching the practical and adaptive die design and making, and their theoretical confidences.<sup>1~3)</sup>



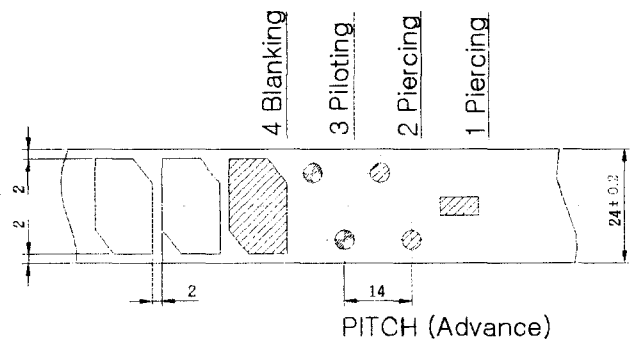
Unit : mm  
 Tolerance of dimension : ±0.1  
 Part thickness : 0.4mm  
 Material : BsP  
 Lot size : 10000

**Fig.1** Production part drawing

### 2. Die Design

#### 2.1 Strip Process Layout

Fig. 2 shows the strip process layout. In this layout, the layout followed the collected press die data base and practical experiences.(see part1 of this study).<sup>4~6)</sup>



**Fig.2** Strip process layout  
 by stop pin of instead of side cutter

#### 2.2 Die Set and Material of Die Components

There are several kinds of die set in data base according to the industrial regularly. Some time, in especially field they make special type die set for high precision die assembling function with steels.

In this study, we considered the hand feeding of strip that causes are mass production less than 10,000

pieces of lot size of production part and necessary of accurate production part.

Hence, the guide post must be installed within die shoe allowance with the fine guide bushing fit.

It was selected that the die set is two guide post type for a precision working and high load of thick wide product in this experimental part.

The die component materials are followed to machinability, heat treatment and harden-ability, distortion, die component life upon a press working and cost site etc.<sup>7-9)</sup>

In this study, we considered that the die is used to less than 10000 pieces of lot size.

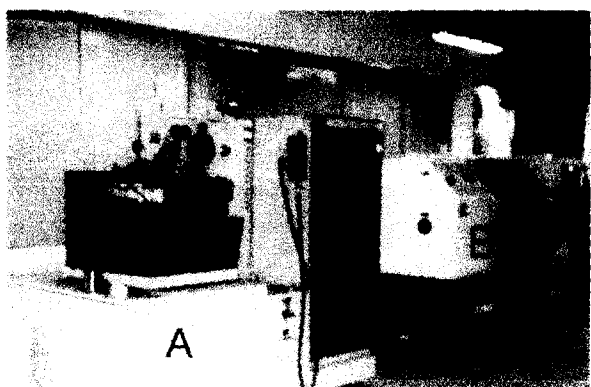
Therefore, die components materials were selected mild steel SM20C mostly except die block and a kind of punches(STD11).

### 2.3 Equipments of Die Making

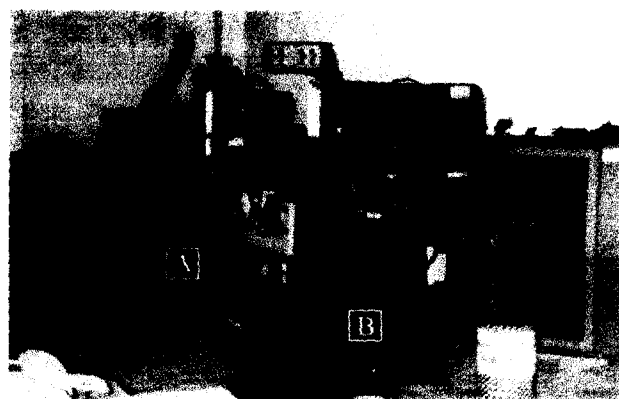
Punch and die block is main part in die making. In this study, We decided the size of punch and die block depending on data base, theoretical background, and experiences.

Fig. 3(a) shows the experimental wire cutting machine and CNC lathe and (b) shows the experimental surface grinding machine too.

The machining of punch and die block can belong to the precision machine tool working, raw material cutting, milling, turning, drilling, shaping, profiling, and then heat treating, electric discharge machining (EDM, WEDM), profile grinding, especially, CNC machining, and mirror machining.



(a) Experimental wire cutting machine(A) and CNC lathe(B)



(b) Experimental surface grinding machine(A) and cylindrical grinding machine (B)

Fig. 3 Experimental machine tools

### 2.4 Result of Die Design

Fig. 4 shows the drawing of die design result. In the figure, we can find the best conditions of the die design database and tooling experiences in working.

Especially, the fixed stripping method is effective press working for lower lot size less than 10,000 pieces through the side cutting system.

## 3. Die Making

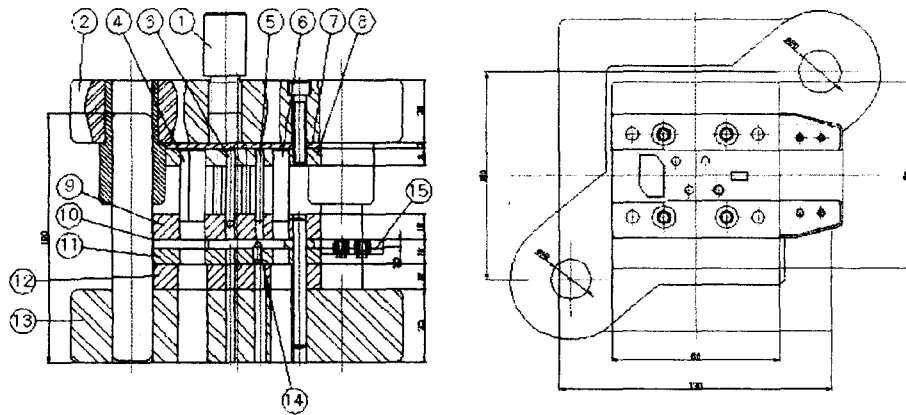
### 3.1 Tryout and Its Analysis

The Part No① of Fig. 5 shows the result of actual strip process layout, and other of this figure shows the die components and assembly, by tryout with a photograph. In this figure, we can be known the practical and adaptive result of this experiment.

The production part through the die shoe was adaptive size with accurate tolerances by assembling function.

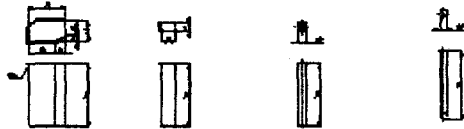
In here, it is proved that the database and tooling experiences is are suitable outputting.

The checking result of part of production by tryout was so fine as its product tolerances obtained through the precision measurement.

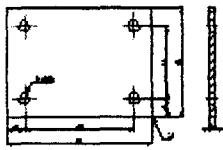


(a) Die assembling drawing

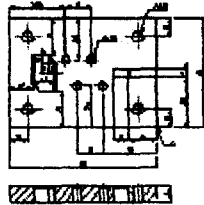
④ Backing Punch ⑥ Piercing Punch ⑤ Piercing Punch ③ Pilot Punch



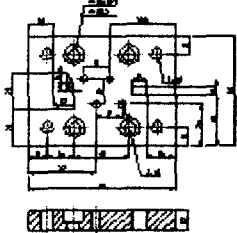
⑦ Backing Plate



⑧ Piercing Plate



⑨ Stripper Plate



⑩ Front Gage

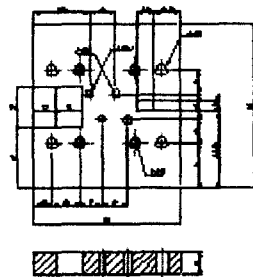
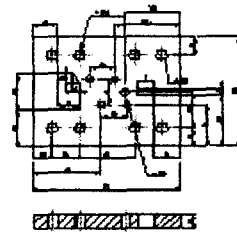


⑭ Stop Pin



⑬ Lower Holder

⑪ Die Plate

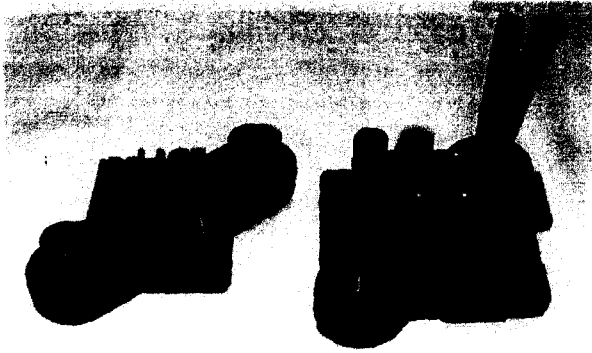


15	Stock Rest	SM45C	30*50*3t		1
14	Stop Pin	STD-11	φ 4*10		1
13	Die Set(Lower)	GC20	Stabdard		1
12	Lower Holder	SM45C	90*80*12t		1
11	Die Plate	STD-11	60*80*8t	HRC60±2	1
10	Front Gage	SM45C	17*110*4t		2
9	Stripper Plate	SM45C	60*80*12t		1
8	Punch Plate	SM45C	60*80*8t		1
7	Backing Plate	STC-4	60*80*3t	HRC60±2	1
6	Piercing Punch	STD-11	4*8*35	HRC60±2	1
5	Piercing Punch	STD-11	φ 4*35	HRC60±2	2
4	Blanking Punch	STD-11	20*12*35	HRC60±2	1
3	Pilot Punch	STC-4	φ 4*38	HRC60±2	2
2	Die set(Upper)	GC20	Standard		1
1	Shank	SM45C	φ 20*42		1
NC	DESCRIPTION	MATERIAL	S I Z E	MEMO	QTY

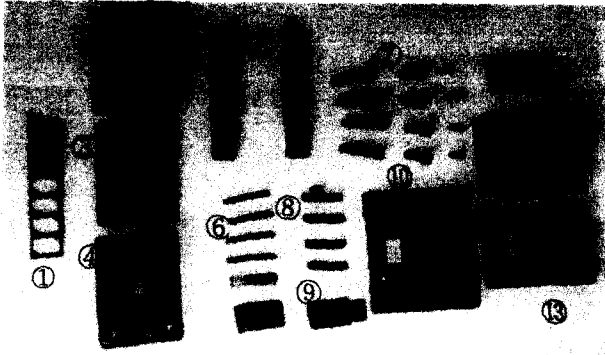
(c) Material list

(b) Die components drawing

Fig.4 Drawing of die assembling and its components



(a) Actual die assembling



(b) Actual die components without die set

- ① Actual strip
- ② Punch holder
- ③ Blacking plate
- ④ Die holder(Upper)
- ⑤ Front gage
- ⑥ Punch
- ⑦ Bolt
- ⑧ Pins
- ⑨ Shank
- ⑩ Die holder(Lower)
- ⑪ Guide stock
- ⑫ Stripper plate
- ⑬ Die plate

**Fig.6** Die assembling and its components

#### 4. Conclusion

In order to prevent defects of die development for thin sheet metal working (piercing and blanking). We studied die design and making through the database analysis, tooling experiences, and then we designed the die assembly and its components.

The results and consideration of actual die making and tryout was obtained the following conclusion.

1. It is effective result that the piloting and fixed strip type die for low quantity products.
2. The simulation of punch and die block's occurring stress during press working can be proved nevertheless outstanding on the site of strength exactly.

3. The development of practical and adaptive die obtained by database and tooling experiences, the reduction of lead time could be obtained too.
4. The piloting behaviour was very exactly to guide of punching position in their tolerances.

#### References

1. D.Egene Ostergaard, "Basic and Advance Die Making" McGraw-Hill Book Co., 1963
2. M. Hadhi Moto, "Pressworking and Die making" Higan Tech. Paper Co., 1975
3. Karl A. Keys, "Innovations in Die Design", SME, 1982
4. Donald F. Eary, Edward A. Reed, "Techniques of Pressworking Sheet Metal" Prentice Hall, Inc., 1974
5. Taylor Lyman, et.al, "Forming" Metals Handbook Vol.4, 1969
6. K-E Theling, "Steel and Its Heat Treatment", Butterworths, 1984
7. T. Hutota "Databook of pressworking Process Design" Press Tech., Vol.7 No.13 High Tech. Paper Co.,
8. I. Naka Gawa, et.al, "Pressworking of Thin Sheet Metals" Sitsu Gey Publishing Co. 1977
9. M. Sei Moto, "Press Progressive Die" Higan Tech. Paper Co., 1969
10. F. Faura, A. garca, M. Estrems, "Finite element analysis of optimum clearance in the blanking process" Journal of Materials Processing Technical. pp.121-125, 1988
11. National Institute Industrial Test, " Press Die Components and Working Standard", 1990
12. Sung-Bo Sim, Young-seok Song, Sun-kyu Park, "Development system of the Scrapless Type Die for Sheet Metal", Proceedings of KSPE Autumn Con. Vol.1 pp.410~413, 1999
13. Sung-Bo Sim, Young-seok Song, "Development System of the Practical and Adaptive Progressive Die for Sheet Metal", Proceedings of KSPE Autumn Con. Vol.1 pp.414~418, 1999