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Development of Multi Forming Product Progressive Die for STS 304 Marine Part Sheet Metal (Part 1)

Sung-Bo Sim*, Yul-Min Sung, Young-Seok Song*****

* *Pukyong National Univ. School of Mech. Eng.*

** *Pukyong National Univ. Industrial Graduate School*

*** *Pukyong National Univ. Graduate School*

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Abstract : *The progressive die are multiple operations performed by means of a die having above two stages, on the each of stages performs a different operation as the sheet metal passes through the die hole. In the field of design and making tool for press working, the progressive die for sheet metal (STS 304, thickness :0.5㎜) is a specific division. In order to prevent the defects, the optimum design of the production part, strip layout, die design, die making and tryout etc. are necessary. 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 materials, heat treatment of die components, know-how and so on. In this study, we designed and constructed a progressive die of multi-stage and performed try out. Out of these processes the die development could be taken for advance. Especially the result of tryout and its analysis become the characteristics of this paper (part 1 and part 2) that nothing might be ever seen before such as this type of research method on all the processes. In the part 1 of this study we treated die design mostly.*

1. Introduction

The design may include components or devices to position, locate or guide the sheet metal strip. Idle stages, at which no works performed, are used spread out, closely spaced or to better distribute the forces regarded to perform the work. The 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 strip stock moves through the die tunnel 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 ordinary product in industrial production line or society of our general living field as this paper subject.

So, this study needs a whole of press tool data, our field experiences, and theoretical instructions.

According to upper knowledges using, this study could approach to the optimum die design. Furthermore the aim of zero defects could be obtained mostly by revision on the try out.

2. Die Design

2.1 Die Development System

Fig.1 shows the die development system. In this system, it can be seen that the production engineering, die making technology, standardization, trouble shooting, man power, purchase, tool, material, etc. are connected to software and hardware, corresponded instructions of wide and deep technology and its theoretical background.

Fig.2 shows the one of die components drawing by Auto-CAD system with Auto Lisp and Window environment, namely, pilot punch drawing. The other die components were followed as this method and experiences.

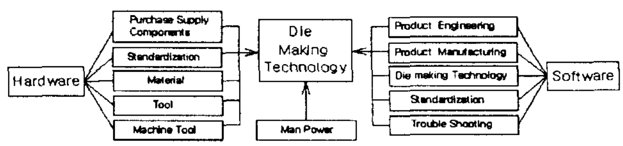


Fig.1 Network of the die development system

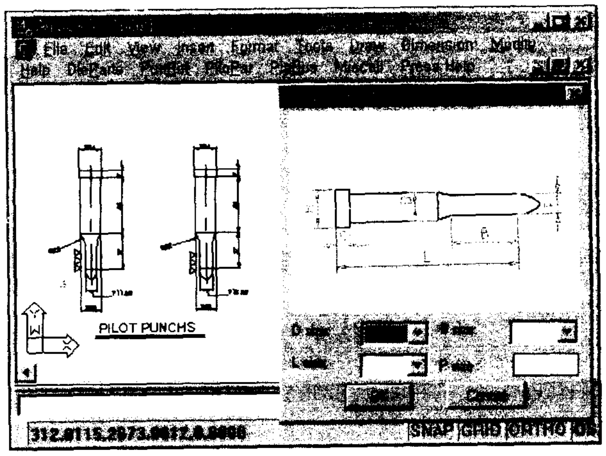


Fig.2 Die component drawing from Auto-CAD and Window environment

2.2 Strip Process Layout

The disposition of part on strip feed unfolding is the display with constant 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 layout must be peformed exactly. Furthermore, on the strip, the part disposition within the turning range from zero degree to ninety degrees is better consideration. Tool designer's intention must consider that the best utilization ratio can be found at the top of part arrangement. This is the optimum method of initial die design. At this time we must refer the web size on the strip from database and experience too. Fig.3 shows the strip process layout design procedure. For the design of strip process layout, the first step is how to decide the feeding method which is according to the quantity of production part, material properties, and material thickness, the second step is same as the flow chart in Fig.3.

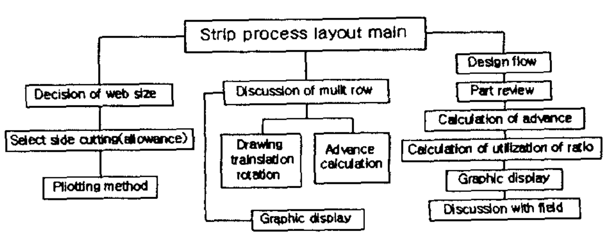
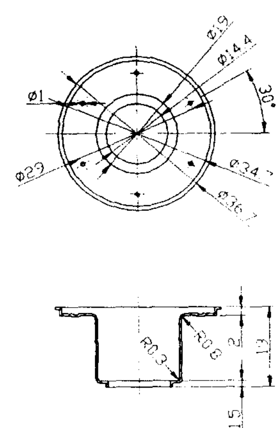


Fig.3 Flow chart of strip process layout design system

Fig.4 shows the production part and its developing blank diameter. The following strip process layout(see Fig.5) was designed from the production part drawing(Fig.4). For the strip process layout, it was considered that the proper sizes are strip width, web size, pitch (advance), side cutting selection (allowance), etc.[3,4] the first stage performs piercing circular lancing ①, the second performs circular lancing② and piloting, third stage works idle, fourth stage works drawing① and piloting, fifth stage performs piloting (pilots work to make the stability of strip feed and location) and drawing②, sixth is drawing③ stage, and seventh stage works drawing④ and piloting too. The eighth stage works piloting and drawing⑤. Ninth stage works thin drawing and piloting, tenth stage works embossing and piloting, eleventh stage is piercing and piloting stage, twelve stage works burring① and piloting, thirteenth stage also works burring② and piloting, fourteenth stage works sizing and piloting. The last of fifteenth stage works trimming, piloting, ejecting of completed part through the out let of die shoe hole and press table hole. Idle stages have function for die allowable space and die trouble shooting of before or next stage failure. Therefore the strip process layout comes in the result as Fig.5 (drawing of strip process layout).



Where, t = 0.5 ㎜, STS 304

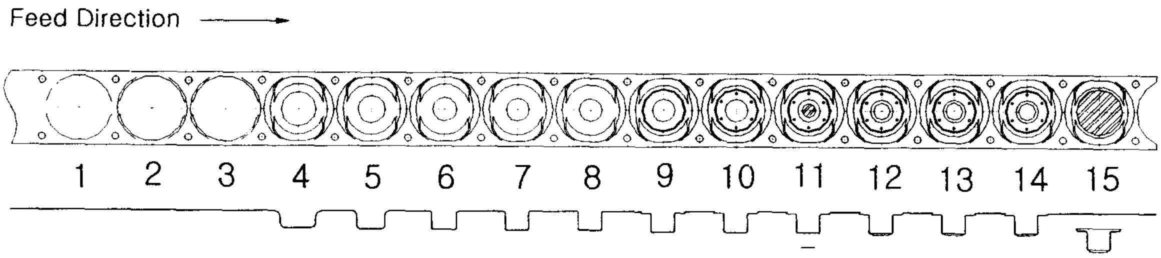
Blank diameter with trimming allowance D ≒ φ 55.5 ㎜

※ $D=\sqrt{d_3^2+4(d_1h_1+d_2h_2)}$

Fig.4 Production part drawing and its blank diameter

2.3 Clearance

This experimental press working material is thin thick just 0.5㎜(BsP). Therefore, the clearance is small amount of 0.02㎜(t*4%) from collected database and practical experiences. At this time the burr at the punch cutting edge can occur, minimized in product tolerances.[5,6]



1 : Circular Lancing-1 Piercing for Piloting **2** : Circular Lancing-2 **3** : Idle
4 : Drawing-1 **5** : Drawing-2 **6** : Drawing-3 **7** : Drawing-4
8 : Drawing-5 **9** : Thin Drawing **10** : Embossing **11** : Piercing
12 : Burring-1 **13** : Burring-2 **14** : Sizing **15** : Trimming
4~15 stage : Piloting in additional function

Fig. 5 (a) Drawing of the strip process layout

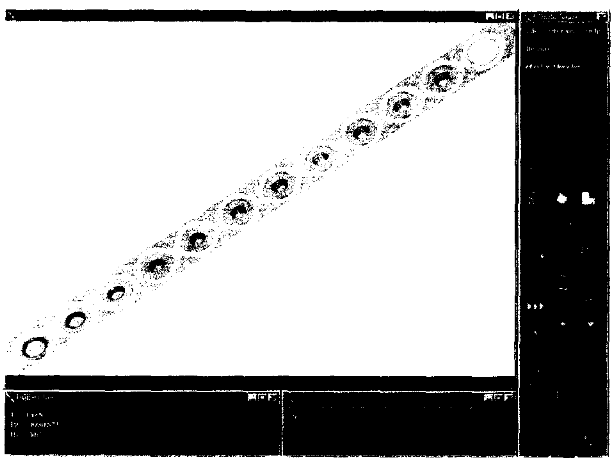


Fig. 5(b) Result of strip process layout Modeling by I-DEAS

3. Die assembling design

There are several kinds of die set in the database according to the industrial today's situation.

Sometime in especial field, they make special type steel die set for high precision die assembling function. In this study, we considered the automatic roll feeding of material strip for mass production above one hundred thousands of lot size of production parts necessary for precision production. Therefore we selected special type steel die set for high precision production part. Also the guide post must be installed in the die shoe block size allowance through the accurate guide bushing fit.

The die set of steels is 4 outer guide posts type for a precision working and high pressing force of production part(additional guide posts were 18 inner guide post in die block region). Fig.6 and Fig.7(a)(b) show the result assembling die drawing.

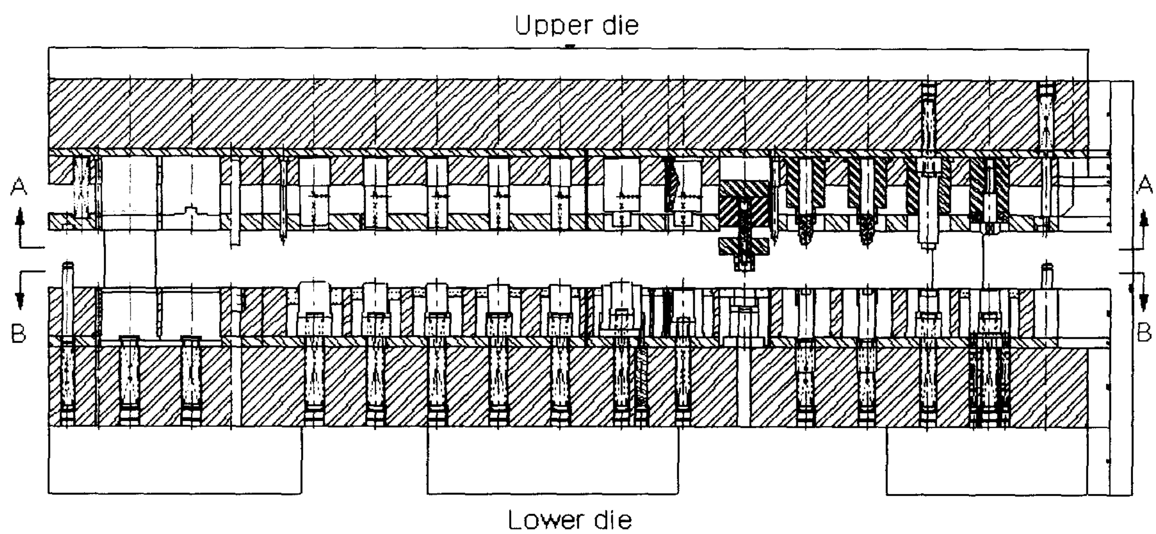


Fig.6 Summary assembling drawing of the die design on front view

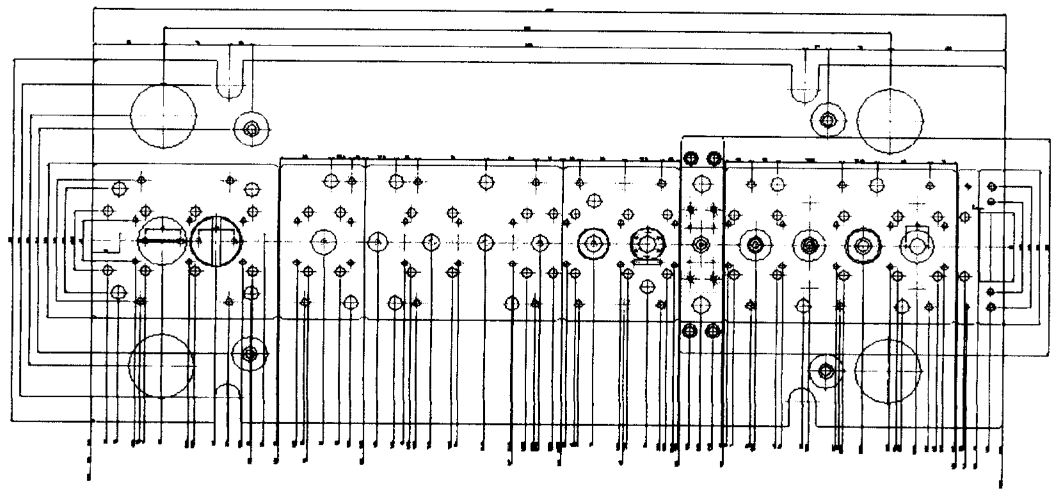


Fig.7(a) Summary assembling drawing of the die design on top view "A-A" of Fig.6

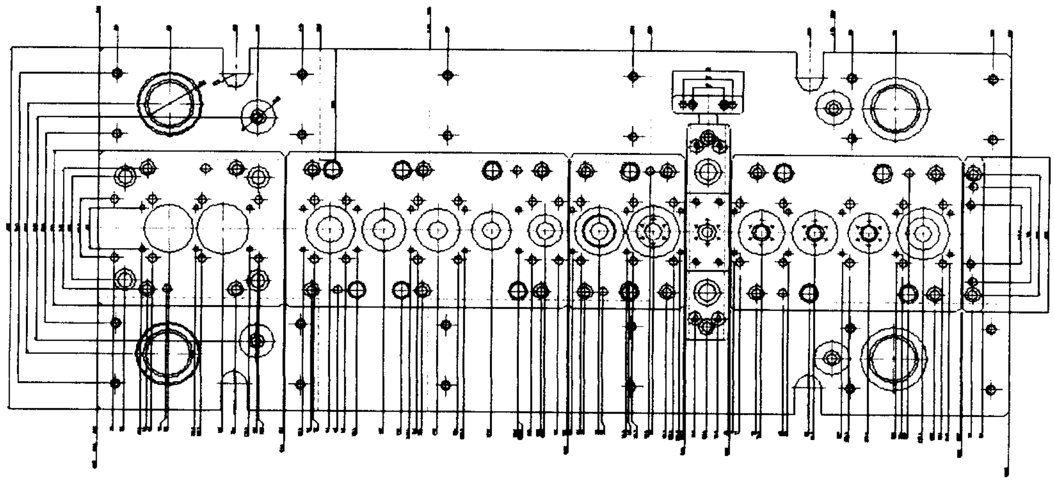


Fig.7(b) Summary assembling drawing of the die design on top view "B-B" of Fig.6

From Fig.6 and Fig.7, we have known the split die design system for easy way die making and approaching to ultra precision die making.

4. Conclusion

In order to prevent the defect of die design and making, this study developed the practical and adaptive die assembling and components.

This study could be carried out by the theoretical back ground, data base and our field experiences.

The result are as follows;

(1) The data base and practical experiences were adaptable for die design.

(2) The result of non-defect quality production part can be obtained from die design to its making.

(3) Computer aided die design was adaptable for die design because it could prevent die making failure.

(4) Die components accuracy of the data base was effective for die assembling design procedure.

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