Analysis of Stock Strip Layout for Blanking Operation in Sheet Metal

Nikhil Chawla¹Yati Parjesh²

^{1, 2} Department of Mechanical Engineering, Shri Baba Mastnath Engineering College,

^{1, 2}Asthal Bohar, Rohtak, Maharshi Dayanand University, Rohtak, Haryana, India.

Abstract— Sheet Metal Operations is one of the basic mechanical operations of forming metal into thin, flat uniform size & required shape part. To name a few sheet metal operations—shearing, blanking, punching, bending, embossing, trimming etc are used to produce a variety of shapes. In this paper, designing of strip layout for blanking operation has been discussed about. A comparison of different layouts for single component has been made to show the relative yield percentage.

Keywords: - Sheet Metal, Strip Layout, Blanking, Scrap Web, Strip Width, Advance Distance, Yield

I. INTRODUCTION

A variety of parts are manufactured using sheet metal operations. The first basic operation after shearing of the metal sheet is blanking, wherein the component is blanked out of a stock strip of metal. So, it is very necessary to design the layout of parts for blanking in such a way that maximum possible stock utilization or yield is obtained. A proper nesting of the parts for blanking operation is a must to produce maximum yield. Even though maximum utilization of the stock is necessary, but the shape & size of the part is of the component is of prime importance. So, the strip layout must be designed in such a way that the part obtained is given priority to the yield percentage of the stock.

The various terminologies associated with stock & scrap strip layout as shown in figure 1 are as below—

- 1. Feed Direction: It is the direction in which stock strip is fed in to the die.
- 2. Lead End: It is the end of the stock strip heading towards the die.
- 3. Tail End: It is the end of the stock strip opposite to the lead end.
- 4. Advance: It is the distance moved by the stock strip in blanking operation between two consecutive strokes of the machine.
- 5. Scrap Bridge: Scrap Bridge is the distance between the peripheries of two consecutive blanks. It is very necessary as it joins & separates the boundaries of two consecutive parts.
- 6. Stock Width: It is the width of the strip in vertical direction from which blanks are blanked out.
- 7. Front & Back Scrap: It is the scrap width in front & back of the blank.

The scrap or stock web to be left on the scrap strip for effective blanking operation depends on the type of blanking, thickness of the sheet, width of the strip, dimension or size of the component & contour of the blanked shape. The table below shows the values of scrap web allowance for various sizes of the parallel edged component.



Fig.1: Scrap Strip Terminology [1] TABLE ISCRAP VALUES FOR VARIOUS MAXIMUM DIMENSIONS

	Dimension A		Dimension B	
Maximu m Dimensio n(mm)	General	Minimu m (mm)	General	Minimum (mm)
Up to 25 mm	1.25T	1.50	1.50T	1.50
26 to 75	1.25T	1.50	1.50T	1.50
76 to 150	1.50T	2.00	1.50T	2.40
151 to 250	1.75T	2.40	1.75T	3.00
251 to 400	2.00T	3.00	2.00T	4.75

Figure 2 shows the dimensions of the object as below--



Fig.2: Component Dimension

Figure 3 shows four types of strip layout for blanking operation for the same component.

Sheet Metal stock is obtained usually in the form of rolls but when in cut sheet, the usual size is

1250X2500sq.mm. So, we too have taken the cut sheet for our calculation. Before discussing on each of the options shown in figure 3 above, the common aspects for each option are—

- 1) Area of the Cross-section of 1 Component
- = (50*10) + (80*10) + (50*10) = 1800 sq. mm
- 2) Area of 1 sheet = 1250*2500 = 3125000 sq. mm
- 3) Thickness of Sheet = 2mm

The various options are worked as below to find to find the yield percentage of each of the method—

A. Option 1

- Maximum Dimension of the component = 100mm
- From Table, for maximum dimension of 100mm, Scrap Web = 1.5(T) = 1.5*2 = 3mm
- Therefore, maximum dimension with 2 components = 100+3+10 = 113mm
- Advance Length = 113+3 = 116mm
- No. of blanks per strip = 1250/116 = 10.77566 ~~ 10 blanks
- But, 2 in number, therefore no. of blanks = 2*10 = 20
- Strip Width = 50 + 1.5(T) + 10 + 1.5(T) + 1.5(T) = 69mm
- No. of strips per sheet = (2500/ Strip Width) = 2500/69
 = 36.23188 ~~ 36 strips
- Thus, total number of blanks per sheet = 20*36 = 720
- Area of total no. of blanks = 720 * 1800 = 1296000 sq. mm
- Therefore, % utilization of stock or Yield %
- = 1296000/ 3125000 = 41.47%
- B. Option 2
- Maximum Dimension of the component = 100mm
- From Table, for maximum dimension of 100mm, Scrap Web = 1.5(T) = 1.5*2 = 3mm
- Advance Length = 100+3 = 103mm
- No. of blanks per strip = (1250/103) + (1250/103) 1
 ~ 12+12-1 = 23 blanks
- Strip Width = 50 + 1.5(T) + 10 + 1.5(T) + 1.5(T) = 69mm
- No. of strips per sheet = (2500/ Strip Width) = 2500/69
 = 36.23188 ~~ 36 strips
- Thus, total number of blanks per sheet = 23*36 = 828
- Area of total no. of blanks = 828 * 1800 = 1490400 sq. mm
- Therefore, % utilization of stock or Yield %
 = 1490400/ 3125000 = 47.69%
- C. Option 3
- Maximum Dimension of the component = 100mm
- From Table, for maximum dimension of 100mm, Scrap Web = 1.5(T) = 1.5*2 = 3mm
- Advance Length = 100+3 = 103mm
- No. of blanks per strip = (1250/103) = 12.13592
 ~~ 12 blanks
- Strip Width = 50 + 1.5(T) + 1.5(T) = 56mm
- No. of strips per sheet = (2500/ Strip Width)
 = 2500/56 = 44.64286 ~~ 44 strips
- Thus, total number of blanks per sheet = 12*44
 = 528

- Area of total no. of blanks = 528 * 1800 = 950400 sq.
 mm
- Therefore, % utilization of stock or Yield %
 = 950400/ 3125000 = 30.41%



Fig.3: Various Strip Stock Layout

D. Option 4

- Maximum Dimension of the component = 50mm
- From Table, for maximum dimension of 100mm, Scrap Web = 1.25(T) = 1.25*2 = 2.5 ~~ 3mm
- Advance Length = 50+3 = 53mm
- No. of blanks per strip = (1250/53) = 23.58491
 ~ 23 blanks
- Strip Width = 100 + 1.25(T) + 1.25(T) = 106mm
- No. of strips per sheet = (2500/ Strip Width)
 = 2500/106 = 23.58491 ~~ 23 strips
- Thus, total number of blanks per sheet = 23*23
 = 529
- Area of total no. of blanks = 529 * 1800 = 952200 sq. mm
- Therefore, % utilization of stock or Yield %
 = 952200/ 3125000 = 30.47%

Thus, seeing all the 4 options, it can easily be said that Option 2 is the best as the maximum stock utilization of about 47.69% is obtained with it. Therefore, option 2 is the most economical method as far as maximum stock utilization is concerned.

II. CONCLUSIONS

Stock Strip Layout is a very important step in designing blanking process in sheet metal operations as the rest of the operations are performed after the part is blanked out of the stock strip. So, proper nesting of the strip must be done so as to obtain maximum yield & less scrap out of the sheet stock. As is seen here, option 2 was nested by making a third blank in between 2 blanks. So, maximum yield has been obtained in it. Here, neither the number of passes to cut the blanks nor the cost of the die has been discussed, which also are a significant factor in designing the stock strip layout.

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