A STUDY ON THE EFFECTS OF JOINT AND EDGE PREPARATION TO PRODUCE COST REDUCTION AND DISTORTION FREE WELDS

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1. Introduction

Even after the design engineer makes a most economical design available, the workshop can undo it by inefficient or careless implementation through incorrect edge preparation, bad fit-up and over welding. The weld sizes specified by the design engineer in the drawing are expected to have a built-in safety factor. Yet workshop people and welders resort to over welding under the mistaken impression that a joint becomes stronger. Over welding increases cost as well as residual stresses and distortion. Over welding occurs due to the following reasons:

- Heavy reinforcement is provided on the butt weld (fig.1).
- Fillet weld size is unnecessarily increased fig.2).
- Fillet weld has high convexity (fig.3).
- Fillet weld has unequal leg length (fig.4).

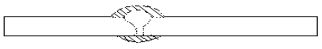

Fig.1 Heavy reinforcement

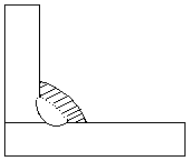

Fig.2 Fillet oversize

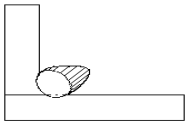

Fig.3 High convexity

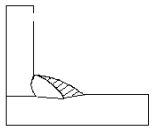

Fig. 4Unequal leg length

Everyone is aware that weld-metal is very expensive and must be used judiciously. But few realize that more weld-metal means more distortion, and the best way of controlling distortion is to use least amount of weld-metal. This paper highlights a study on the effects of joint and edge preparation to produce cost reduction and distortion free welds.

2. Experimental procedure

The workpieces are of mild steel. The welding technique is shielded metal arc welding. Fillet and butt welds were designed to study the effect of joint and edge preparation. The gap and included angle between the workpieces were also varied.

3. Results and Discussion

3.1 Effect of fillet size of shape

The effect of fillet size on the weight of weld metal is shown in fig.5 and Table-1. When the weld size was increased from 6 to 8mm, 84% of extra metal was found added to the joint. This gives remarkable judgment not only on the wastage of electrode material, electric power, and manpower but also induction of thermal stresses and distortion in the joint and parent metal. Fillet weld size should be carefully specified by the designer and strictly controlled during fabrication by using fillet gauges and standard welding procedures.

Table-1: Effect of fillet size

Size of fillet (mm)	weight of metal (g/m)		
3.15	48.3	58.9	55.9
4.80	108.7	131.4	125.3
6.30	194.8	234.0	222.0
8.00	303.5	365.4	347.3
9.50	436.4	527.0	500.0
12.70	776.1	936.0	889.4

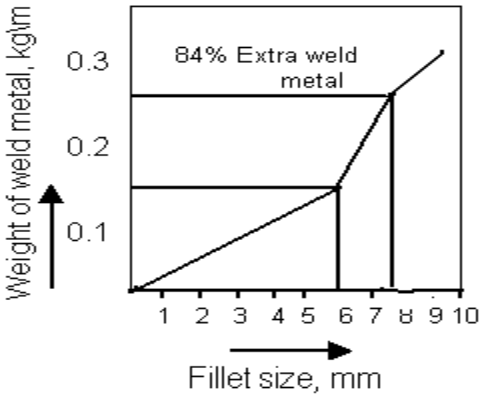

Fig.5 Effect of fillet size on the addition of weld metal

3.2 Effect of Edge Preparation

The effect of edge preparation on the weld metal deposited is illustrated in fig.6. In butt joints, the type of joint was made of edge preparation, which could determine the amount of weld metal and distortion.

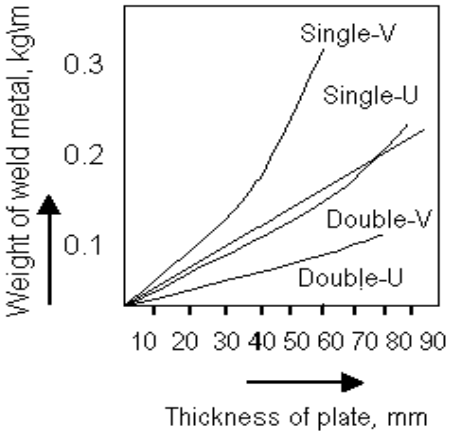

Fig.6 Effect of edge preparation on the amount of weld metal deposited

In single sided edge preparation the welding is not balanced about the neutral axis of the plate, and angular distortion increases with plate thickness. If plate thickness is above 12mm, double sided edge preparations are economical because of the saving in weld-metal. At thickness above approximately 40mm, a double-U preparation may achieve sufficient saving in weld metal to justify additional machine costs.

3.3 Effect of gap between plates for butt joints

The design of gap for butt joints between plates determines the soundness of the weld. The effect of gap dimensions on the weld metal is demonstrated through Table-2. When the thickness of the plate is increased it is necessary to increase the gap between plates. The optimum size of the gap is more selective for the sound joint. As the gap size increases for a particular size of the plate, the weld metal deposited in between the plates increases. This directly influences the cost of welding and distortion in the plates.

Table-2: Effect of gap between plates

t, mm	g, mm		
	1.6	3.2	4.8
	wt. of metal, g/m		
3.2	40.8	80.0	122.4
6.3	80.0	160.0	320.0
9.5	122.4	244.8	367.2
12.7	160.0	320.0	480.0
15.8	200.8	401.5	602.4
19.0	240.1	480.2	720.2
22.2	280.0	560.0	840.0
25.4	320.1	640.2	960.3

3.4 Effect of included angle for butt joints

Fig.8 shows the effect of included angle provided between the plates. It is observed that the amount of metal deposited between the plates is directly proportional to the included angle between the plates.

Table-3 Effect of included angle between the plates

t, mm	θ	
	60	70
	wt. of metal, g/m	
3.2	46.81	55.9
6.3	185.70	225.0
9.5	416.70	504.3
12.7	741.40	898.4
15.8	1156.60	1404.3
19.0	1676.10	2023.4
22.2	2265.0	2748.2
25.4	2960.0	3543.8

Conclusions

Over welding does not give the impression of strong joint. Over welding results residual stresses and distortion in the plates as well as wastage of time and electric power. An optimized design of the joint results an economical and sound welding.

References

1. Parmar R.S, Welding processes and technology, Khanna Publishers, Delhi, 1992.

2. Weisman C, Fundamentals of welding, Welding Handbook, Vol:1, 7 th edition, American Welding Society, London, 1981.