Determining the Cost of Welded Joints

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RELATIVE COST FACTORS are presented which relate the cost of fillet and groove welds of common sizes to the cost of a single pass ¼-in. fillet weld having an assigned cost factor of 1.00.

Knowing the actual local cost of a ¼-in. fillet weld for various conditions, the relative cost factors presented may be used to determine the actual cost of welds of various kinds and sizes.

The actual costs of fillet and groove welds are obviously best determined from rather precise time-studies, wherein the value of all variables may be determined. Many of the variables are different for each fabricating shop. These weld cost variables include joint design, weld process, welding position, operating factor (arc-time vs. total time), fit-up, local costs for material, labor, power, etc.

RELATIVE COSTS—FOR DESIGNERS

To the structural engineer, in the midst of a specific design problem, these variables cannot be known, since the fabricator is not yet known. However, the designer must make decisions such as:

Whether or not to splice
Large fillet welds vs. groove welds
Appropriate groove weld
Should plug welds be used?
Short large fillet welds vs. long small fillet welds

In most cases the engineer is concerned with relative costs rather than actual dollar or man-hour costs.

To aid designers in making prudent decisions, the relative cost factors presented in Table 1 are suggested. In the opinion of the writer, the comparison factor idea well serves the purpose and has not been generally available to most design offices.

Referring to Table 1, it should be noted that the relative cost factor for a ¼-in. 45° fillet weld is established as 1.00 and other factors represent the *relative* cost of other welds compared to a ¼-in. fillet weld. Although shown schematically, all groove weld geometry is comparable with AWS full-penetration joint designs without back-up or spacer bars and may or may not be prequalified AWS joints. Factors are based on welds being made in a single position, i.e., all down-hand, all horizontal, etc., and not a combination of weld positions.

The factors presented in Table 1 may also be termed "conversion" factors, since the footage of any weld when multiplied by its factor represents the equivalent footage of a ¼-in. fillet weld.

These factors have been determined from time-studies and experience checks at several locations and do not represent a mathematical solution only, nor merely a comparison of weld volumes. Note that a ½-in. fillet weld contains 4 times the volume of a ¼-in. fillet weld; however, its factor is 2.60.

Although the table was originally prepared for manual welding, the same *relative* factors apply when semi-automatic or automatic processes are used.

Because of the wide variation in equipment and methods used for edge preparation, such costs should not be generalized and are not included in the relative cost factors presented, nor are the costs for fit-up, preheat, and cleaning included.

All groove welds require edge preparation, some more than others. Double-V and double-bevel welds require an additional cut which causes a nominal increase in total cost but reduces weld volume. In the final analysis, fabricators will prefer and select joint designs which best suit their *local* cost situation.

COST ESTIMATING—FOR FABRICATORS

The concept of relative cost factors may be extended for use by estimators to determine actual dollar cost or man-hour cost. Such use is especially appropriate for weldments, i.e., plate girders, box members, built-up columns, trusses, rigid frames, special weldments, etc., where welding is the major item of total cost.

For cost estimating, an accurate takeoff of weld footage for kind and size of weld is needed; in itself, this reduces risk and "guesstimating." In addition, a set of *local basic costs per foot* are needed, i.e., costs for a ¼-in. fillet weld made under selected conditions, such as fit-up, type of electrode, weld position, and whether manual, semi-automatic, or automatic process. These must be

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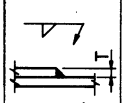
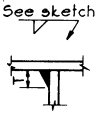
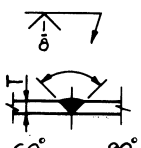
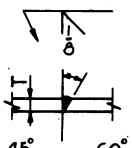
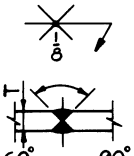
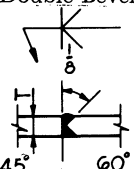
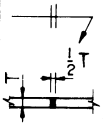
Table 1. Relative Cost Factors For Welded Joints

(BASED ON A COST FACTOR OF 1.00 FOR A 1/4-in. 45° FILLET WELD)

Type / Size (T) in.	Fillet 45°	Fillet 60°–30° See sketch	Single V		Single Bevel		Double V		Double Bevel		Sq. Groove	Plug Welds (per 100 holes 1 in. deep)	
			 60°	90°	 45°	60°	 60°	90°	 45°	60°		Dia. of Hole (in.)	Cost Factor
1/16	0.55	0.65	—	—	—	—	—	—	—	—	0.55	7/16	25.20
1/8	0.70	0.80	—	—	—	—	—	—	—	—	0.60	9/16	39.50
3/16	0.85	0.95	—	—	—	—	—	—	—	—	0.80	11/16	57.50
1/4	1.00	1.25	1.35	1.75	1.30	1.35	1.20	1.30	—	—	1.00	13/16	78.80
5/16	1.20	1.75	1.95	2.70	1.80	1.95	1.45	1.75	—	—	1.20	15/16	104.00
3/8	1.45	2.55	2.70	3.60	2.50	2.70	1.85	2.50	1.75	2.00	1.50	1 1/16	132.00
7/16	2.00	3.30	3.45	4.95	3.15	3.45	2.40	2.90	2.20	2.50	4.80	1 3/16	165.00
1/2	2.60	4.20	3.80	5.10	3.50	3.90	2.90	3.70	2.70	3.10	5.55		
5/8	3.80	6.30	5.55	8.00	5.05	5.55	4.70	5.40	3.80	4.30	—		
3/4	5.30	8.90	7.85	11.50	7.10	7.90	5.45	7.55	5.05	5.85	—		
7/8	7.10	12.00	10.20	15.30	9.10	10.22	7.05	10.10	6.45	7.55	—		
1	9.15	15.50	12.80	20.15	11.50	12.95	9.15	13.25	8.20	9.65	—		
1 1/8	11.50	19.50	15.70	25.60	14.15	15.95	11.15	16.45	10.00	11.80	—		
1 1/4	14.10	24.00	19.00	30.20	16.90	19.10	13.15	19.85	11.90	14.10	—		
1 3/8	17.00	29.10	22.50	35.70	20.15	22.75	15.70	24.00	14.10	16.70	—		
1 1/2	20.00	34.50	26.40	42.85	23.60	26.75	18.30	28.10	16.40	19.60	—		
1 5/8	—	—	30.90	49.80	27.30	31.20	20.80	32.50	18.70	22.60	—		
1 3/4	—	—	35.40	59.00	31.20	35.60	23.40	36.90	21.00	25.40	—		
1 7/8	—	—	40.00	69.20	35.50	40.40	26.20	41.15	23.30	28.20	—		
2	—	—	45.00	79.00	40.00	45.50	29.00	46.40	25.60	31.10	—		
2 1/8	—	—	—	—	—	—	—	—	28.00	—	—		
2 1/4	—	—	—	—	—	—	—	—	30.40	—	—		
2 3/8	—	—	—	—	—	—	—	—	32.90	—	—		
2 1/2	—	—	—	—	—	—	—	—	35.60	—	—		
2 5/8	—	—	—	—	—	—	—	—	38.70	—	—		
2 3/4	—	—	—	—	—	—	—	—	42.00	—	—		
2 7/8	—	—	—	—	—	—	—	—	45.45	—	—		
3	—	—	—	—	—	—	—	—	49.00	—	—		

Notes: Factors apply to all weld processes.
A single weld position is assumed for entire weld.

local basic costs appropriate only for each shop and each condition.

It follows that estimated cost of a specific weld is:

Footage × Factor × Local Basic Cost per Foot

Using this approach estimates can be prepared rapidly, with low risk, and with consistency; also these data aid in determining final joint design desired, process to be used, and welding supplies needed for the job.

There is no substitute for precise cost knowledge. However, business demands compromises, and one such tested compromise has been presented here.