

Weld Cost Estimation Based on Cumulative Database

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ABSTRACT: This paper presents a methodology by which estimation of cost in welding can be done using basic principles of welding and integrating it with software having a cumulative database which will facilitate the end user or a company to build the database and estimate the costs required for welding an assembly breaking it into parts and type of weld. The cost estimated would be made using scientific approach considering time required for each operation, consumables and cost associated with it also the method proposed reduces the manual input parameters as the database builds up minimizing errors. To Show the developed methods interest and the efficiency of the model a prototype has been tested ,the results obtained are compared to real time made by welding staff prove the rapidity and accuracy of this model .

KEYWORDS: Welding costs, Database, manual input parameters.

Nomenclature

ρ : density of filler metal
 ϕ : the process depending on the operator efficiency,
 p : this coefficient depends on the complexity of the weld positioning and of the assemblage type.
 L : welding length, M,
 SS : welding section.
 C_l : Labour hourly cost, rs.min⁻¹
 t^f : Welding operation time,
 D_a : The filling metal massing according to the welding process and intensity.
 m_a : The filling metal mass
 C_e : Electrode cost by mass unit, *rs.g⁻¹
 D : The gas for protecting density, g (gas).cm⁻³
 X : Gas volume flow, cm³.min⁻¹
 C_g : Gas cost by mass unit, *rs.g⁻¹
 I : The current intensity, A
 U : Electric current tension, V
 C_k : Electric energy cost, *rs.kWh⁻¹
 D_m : metal removal rate m³/hr
 b : bevel angle in deg

 t : thickness of plate
 g : root gap

I. INTRODUCTION

Welding is a manufacturing process that is being carried out in almost every industry. It includes various parameters like difficulty in weld position, type of weld, material, thickness ,filler metal used, type of process used for welding .thus with increasing no of parameters it is difficult to calculate the cost associated with it each time

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and so an rough estimate is applied as we know that Costs studying is one of the basic imperatives of any decision making for enterprises working on request. In fact, the accuracy and the rapidity of cost estimation govern the transition to the effective order by the customer and help the enterprise to develop. At present, several data processing tools have been developed to evaluate the time and the manufacturing cost of mechanical parts. Bouaziz et al. [1] have proposed a system for the manufacturing cost of tools based on the semi-analytic approach. Shehab et al. [2] have developed a system which permits the modeling of production costs basing their theory on the integration of cost factors, of product developing activity and of the product geometry. The estimation is based upon connecting conception parameters and production parameters. Jung [3] developed an estimating system of a feature based cost for machined parts. Cost estimating for all features in a category is based on manufacturing activities. cost estimation for welding involves machining cost for edge preparation and welding cost which is tedious to calculate for each different assembly, in this paper a methodology is used to develop an software which will cumulatively accumulate company's data reducing error and manual inputs over the period of time, initially various formula has been applied to calculate welding consumables cost , the basic indicator is time involved in various actions for various processes and mass of weld deposited .

II. COST AND TIME ESTIMATING MODEL

A. Weld Labor Cost The welding operation executing time is the arc time corrected thanks to the [6] Operator efficiency and to the coefficient of the positioning difficulty:

$$t^s = \frac{\rho \times p \times d}{\phi \times \eta \times D} \times SS \times L \quad (1)$$

Where, SS (area of weld bead for butt weld) can be calculated as[4] :-

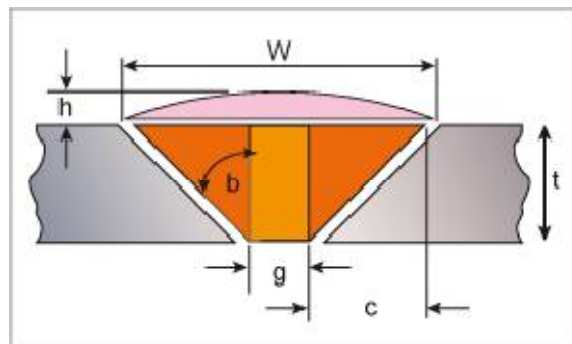


Fig.1. Butt Weld Area

$$SS = (((\tan b \times t) + g) \times h) + g \times t + 2 \times (\tan b \times t) \times t \quad (2)$$

$$C_{SMO} = t^s C_s \quad (3)$$

B. Electrode Consumption Cost The electrode consumption cost is equal to the produce of the filling metal mass deposited and the electrode cost by mass unit. It is given by the following relation:

$$C_{SEL} = m_a C_e \quad (4)$$

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C. Gas Consumption Cost The gas consumption cost is the produce of the consumed metal mass with the gas cost by mass unit. It is expressed as follows:

$$C_{GA}^S = \frac{D \times X}{D_a} \quad (5)$$

D. Electric Energy Consumption For a welding operation the electric energy cost represents the consumed energy power used to deposit the volume of matter ma multiplied by the hourly cost. The electric energy consumption cost is given then by the following expression:

$$C_{EE}^S = \frac{U \times I \times m_a}{60 \times \mu \times D_a} C_k \quad (6)$$

E. Weld Preparation Cost

$$C_{SMa} = (SS - g \times t) \times D_m \times C_{ms} \quad (7)$$

So the total cost is

$$CS = C_{SMO} + C_{SEL} + C_{SGA} + C_{SEE} + C_{SMa} \quad (8)$$

III. DATA BASAE AND ANALOGY

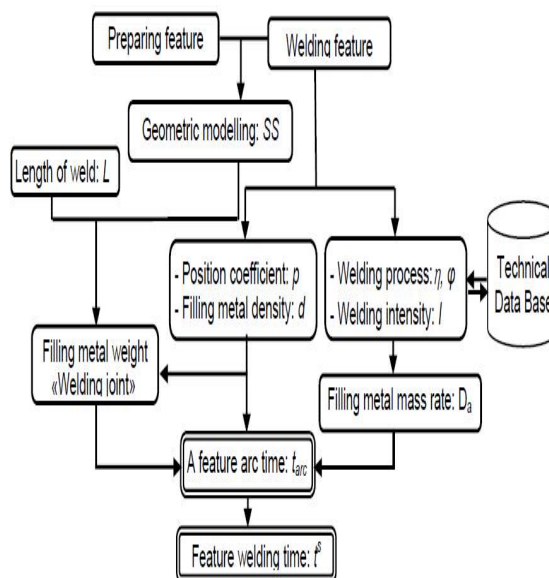


Fig.2. Flow Methodology

Various database have been formed considering all the parameters possible and commonly used processes , the rows in database can be changed as per companies requirements ,but certain databases with constants has been created such as position coefficients ,operational factors of different processes while the variables which depends on

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



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company to company like labor overhead costs, cost of electricity per unit etc has to be fed initially which can be stored and recalled whenever needed.

Table 1 An example of an extract from the technological data base : welding processes

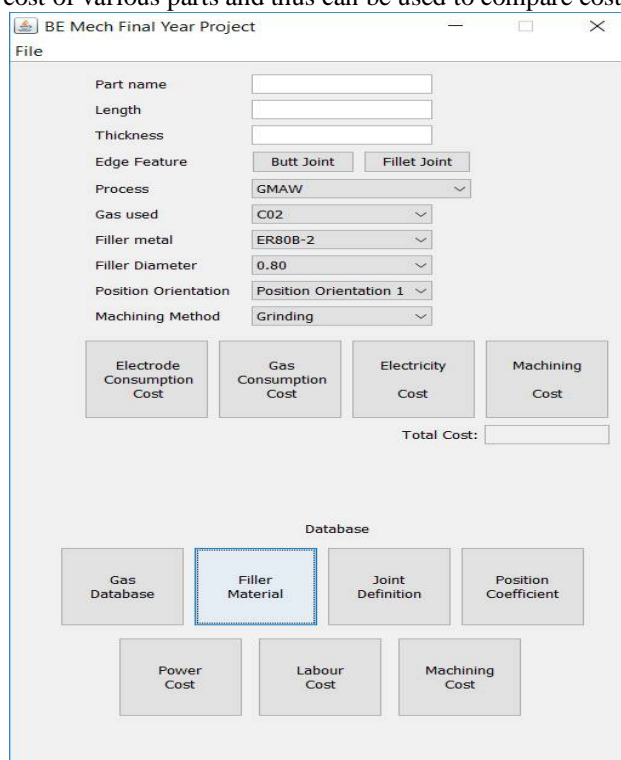
Code	Process	Designation	Source	Protection	Efficiency process : η	Efficiency operator : φ
111	SMAW	Shielded metal arc welding	Electric arc	Solid flux	61%	30%
131	GMAWMIG	Gas metal arc welding "Metal inert gas"	Electric arc	Inert gas	98%	50%
135	GMAWMAG	Gas metal arc welding "Metal active gas"	Electric arc	Active gas	88%	50%
136	FCAW	Flux cored arc welding	Electric arc	Solid flux	86%	50%
141	GTAW	Gas tungsten arc welding	Electric arc	Inert gas	97%	70%

Table 2 An example of an extract from the technological data base: welding position

Code joint	Type	Position	Reference AFNOR	Difficulty coefficient: p	Figure
1	End to end	Flat	PA	1.00	
2	Angle type	Flat	PB	1.05	
3	End to end	Cornice type	PC	1.08	
4	End to end	The ceiling	PE	1.10	

IV. APPLICATION

An front interface has 3 inputs, which has to be made by user ,consisting of plate thickness ,weld length , and part name ,hence for each type of weld there needs to be part name defined ,which would be added making it the entire assemblage and thus the cost. This interface has an option to change the values previously fed and the drop down options contain different processes, gas used ,position during welding etc also it contains edge preparation options in which the edge bevel angle ,root gap etc can be adjusted and saved . As the database gets updated according to company the manual feed reduces and thus faster and more accurate results will be available. The graphic user interface also contains facility to check cost of various parts and thus can be used to compare costs of different process.



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V. CONCLUSION

We have explained the concept and the basic principle peculiar to our approach of time and cost estimating in parts welding. The model by feature which we have developed is characterized by the weld geometric description and by the volume defining of the material added in welding. The formalization of the welding time is carried out by an analytic method of gas and electrode consumption according to the feature different geometric parameters and to the welding process. The cost estimating is assured by a parametric approach. The model includes all the stages of the welding process: preparation and weld. To automatize the cost generating process, it is necessary to integrate the modelling of knowledge, the modelling of the arguments for the generating of preparation and weld features allowing the identifications of the features cost as well as their suitable inductors. Extending the proposed approach to this direction is our interesting research perspective.

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