Observation of Welding in India

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It is an honour to be asked to speak to the Bombay Chapter of The Indian Institute of Welding.

I understand that among you are Chief Executives, Plant Managers, Shop Supervision and Welding Engineers.

I am going to assume that you all have the same common goal—to produce quality products at the lowest cost.

I am therefore first going to give you my observations of welding in India and then I am going to discuss some of the things that reduce the cost of welding.

I have been in India for a little over two years. I first went to the Rajasthan Atomic Power Project Site near Kota in Rajasthan. Right now they are in the final stages of commissioning before they begin bringing the heavy water level up to where the reactor will go "critical"—that is, begin to sustain a chain reaction.

This atomic power station is a maze of piping. Carbon steel, 5% moly, copper, and stainless steel. As might be expected, there are many vessels and tanks and some sophisticated machinery also. It was part of my job to observe welding of vessels fabricated at site and piping both in the site shops and in position.

About a year ago I came to Bombay and have been associated with inspection and testing in several of the larger fabrication plants in the Bombay area.

Here are some of my observations.

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I. Welding Machines

The equipment used in India, whether indigenous or imported is up to world standards.

I am sure that all of you know of the various welding processes available.

—manual metallic arc
—semi automatic submerged arc
—full automatic
—Tig & Mig both manual and automatic
—CO_2 Mig
—Special Welding Processes.
—Plasma welding
—Laser Beam
—Electron Beam
—Friction
—Flash
—Upset
—Electro slag

I think you will agree with me that the greatest majority of welding in India is by metallic arc, with a few large plants having submerged arc and TIG and MIG processes. One or two plants in India have Electro slag enquipment also.

II. Maintenance

Although the new equipment is up to world standard, maintaining the equipment to a good standard is quite another matter. This calls for a planned preventive maintenance schedule as well as prompt attention to defects.

I find almost a total lack of regard for maintenance here in India :

—Machines get filled with shop dirt and are never cleaned.

—Covers fall off and are never replaced.

—Rheostats get faulty and the machines are used anyway.

—Terminals get corroded and/or damaged.

—Insulation breaks and is not repaired.

All of these things affect the output of the machine. In addition, frayed cables and poor ground clamps mean that the welding operator is relying solely on his own judgement as to the current required. And the current output is as good or bad as the welding operator.

The end result of poor maintenance is unreliable machine performance *plus* increased maintenance costs when the machines finally break down completely. The repairs are really costly then.

Preventive maintenance helps give good weld quality and *saves you money.*

III. Welding Consumables

There are several companies manufacturing manual metallic arc welding electrodes for mild steel, low alloy, hitensile and stainless steel applications.

The opinion of Indian fabricators is that the quality is not consistent. For nuclear applications the tendency is to import.,

However, several rods from various Indian companies are approved for nuclear work and I am sure that others work well in other fields. I dont think that Indian manufacture of "stick" electrodes is behind world standards. Getting core wire and coating material with the right chemistry might be a problem.

There seems to be a real problem in the production of indigenous wire and flux for automatic welding. This may be due to the fact that steel is in short supply and automatic welding still constitutes only a small percentage of the consumables used. Therefore it may not yet be economical to develop wires and fluxes commercially.

In my opinion it is important to develop the best without delay. If industry can't do it, government should undertake it. This could be, should be and probably already is being promoted by this organization (I.I.W.)

IV. Design Engineering

Design engineering appears to be as capable in this country as in any other as regards welding. They also make the same mistakes. If they calculate that a $\frac{1}{4}''$ fillet is adequate for strength they call for a 5/16″ fillet "just to be sure". This adds 30% to the cost of labour and material. As a by product, I've noticed that the shop apparently doesn't believe engineering and just to be on the safe side they call for 3/8″ fillet or may be more. And so the costs are increased further. Distortions take over. Dimensions change and too much welding works against you all the way. See Figure 1.

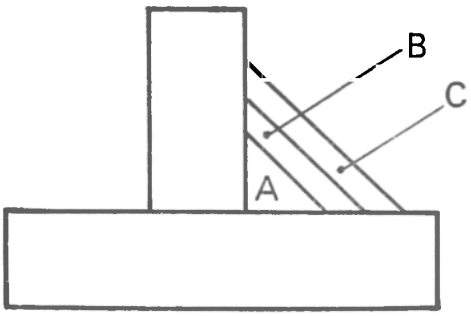

Fig. 1. $A=\frac{1}{4}''$ *Calculated Strength*
$B=\frac{1}{16}''$ *Added by Engineering "just to be sure"*
$C=\frac{1}{16}''$ *Added by shop "just to be sure"*

Addition of 'B' costs	*30%*	*more*
Addition of 'C' costs	*30%*	*more*
Total Add. cost	*60%*	*more*

Let the engineer call for the calculated strength only and expect the shops to give him just that and no more.

The engineer can also effect economies in clearances fit-up and decision on whether to use continuous welds of one size or intermittent welds of another size, as well as accessibility for welding. See figures 2A & 2B.

V. Welding Engineer

The welding engineer has the single largest contribution to make to the economy of welding.

In the quoting stages of a contract, he must study the most economical way of producing the fabrication.

—He must liaison with the design engineer to help select the right joints for economical fabrication.

—He must choose the process.

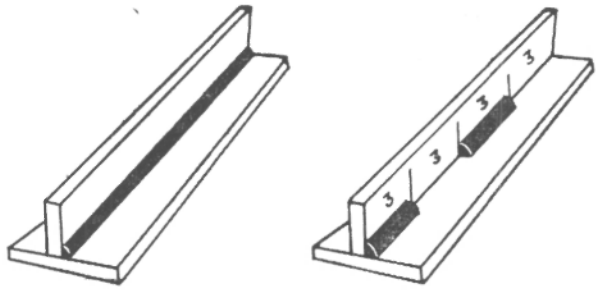

Fig. 2A. Both of these welds have equal strength but the $\frac{1}{4}$" continuous fillet can be produced at least $2\frac{1}{2}$ times faster than the $\frac{1}{2}$" intermittent fillet.

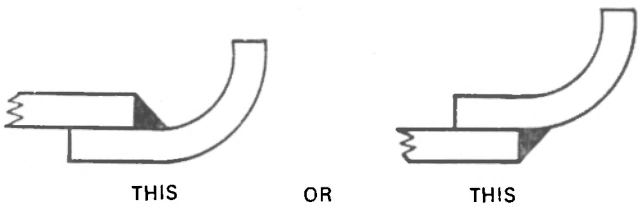

Fig. 2B. The Engineer must design with accessibility in mind for truly low cost welding.

—He must estimate the cost of the welding for quoting purposes and he can only do that by knowing exactly how he will fabricate.

In the manufacturing stages :

—He must ensure adequately trained welding operators.

—He must ensure that his consumables are qualified.

The welding engineers in India that I have talked to are excellent when quoting the specs, referring to electrode types, process etc. They can also write a spelendid welding procedure, but I don't yet know whether the Indian Welding Engineer can really get on the shop floor and tell a good weld from a bad one or show an operator how to weld.

I see shop welding instructions issued which supplement the welding procedures. And the shop welding instructions are as pretty as the procedures.

I've found that the welding operator is individually very good at actual welding. His skill probably reflects the great artistic ability that I see about me everywhere in India. But should he be expected to take the procedures and instructions and use them on his own without verbal explanations and demonstrations ?

Unless the welding conditions of procedures and instructions are clearly understood and used they become merely words on paper. Some one has to take on the job of showing the shop welder the importance of following procedures. Is this a function of the welding engineer ?

VI. Shop Supervision

With regard to welding I find this area generally weak anywhere but in India it is even weaker.

The supervisor doesn't seem to appreciate the bad effects of lack of cleanliness, improper welding sequence, using too much weld metal, or other bad welding practices. The supervisor is chosen for his general knowledge of shop practice and his leadership qualities but all to often, his welding knowledge is minimal and has a lot of things to think of besides welding quality. Consequently the welding is often left to the welding operator. See figure 3.

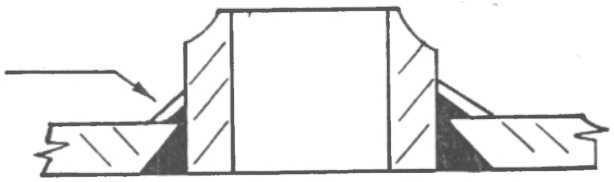

Fig. 3 Actual example of poor supervision. Drawing called for $\frac{3}{8}$" fillet. Some of the welds were as much as 1".

VII. Welding Technicians

What is the answer ? I feel that the gap in India could be filled by welding technicians who know practical welding and know the effects of all the parameters on producing a good weld.

The technician could fill the gap between the welding engineer and the shop floor.

His duties would include bridging the gap from welding engineer to shop floor such as :

a) Discussing procedures and shopwelding instructions with the shop and Inspection.

b) Implementing a preventive maintenance programme.

c) Seeing that welding materials are properly cared for.

d) During fabrication, assuring that parameters of the procedures are met and instruct if necessary on the spot.

e) Work with Inspection to assure quality control check at proper place.

The welding technician also has a place in laboratory work in training welders and in testing of procedures and performance qualification.

I believe that there is a real gap between welding engineering and production in India which could be filled to good advantage by welding technicians who are *not afraid to get their hands dirty.*

VIII. Quality Control and Inspection

All over the world, quality control and inspection is considered by management as a necessary evil.

It is no different in India.

The calibre of the quality control and inspection personnel that I have to deal with in India is excellent, but their specific knowledge related to welding is weak. Everyone knows, however, that QC & I cannot function effectively unless it is completely free from production pressures and reports only to top management.

Unfortunately it appears that production pressures are generally brought to bear on QC & I here.

This defeats the purpose of QC & I and makes outside agencies like ours very wary of the institutional QC & I under these circumstances especially when we already see evidence around us that the Indian appears to be satisfied to settle for second best. How are you going to get your quality up this way ?

IX. The Economy of Welding

India is right now where North America was say 10-15 years ago.

That is. the bulk of welding is manual metallic arc but the processes of submerged arc, TIG and MIG are beginning to have limited operation in the larger shops where the processes are necessary such as TIG and MIG for stainless steel, monel, aluminium and copper and the submerged arc where economies of scale justify their purchase.

Because the bulk of welding is manual metallic arc the following comments on economy generally refer to this process,

In controlling welding throughout the contract cycle from the production of design drawings to final shipping the welding engineer must know and use the general rules that result in economical use of welding :

A. Use the minimum amount of weld metal.

B. Set up procedures to control or minimize distortion. See figure 4.

Rule I. Reduce the effective shrinkage force
Rule II. Make shrinkage forces work for you
Rule III. Balance shrinkage forces with other forces.

Fig. 4. Rules for distortion control.

C. Plan to weld in flat and horizontal where possible.

D. Select proper type of current output.

—DC for thin sections and out of position work, Special applications & stainless steel.

—AC for heavy sections and no arc blow, Flat & Horizontal Welding.

E. Select proper electrode type :

—use largest electrode

—use highest current

—use fastest travel speed

The above will give lowest cost per foot of weld as well as minimum heat input for better distortion control.

F. Get good fit-up.

A. No gap=100% procedure speed

B. 1/16″ gap=80% procedure speed

C. 1/8″ gap=40% procedure speed

Or put another way, a 1/16 gap on a 1/4″ fillet will cost you 30% more in materials and labour. See figure 5.

All the above supposes a good control of the shop output. In fact, I find this far from the case. Very few shops on the North American continent work at an operating factor of 50%; 30% to 45% is considered a good high average.

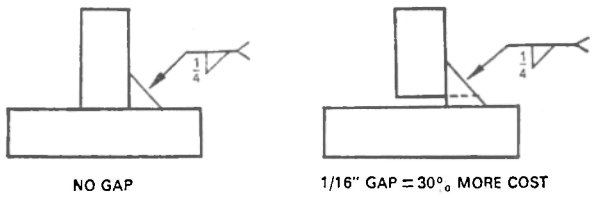

Fig. 5. Ensure good fit-up at all times.

The operating factor is the percent of the time the operator is actually striking the arc. He could'nt keep the arc going 100% of the time but the more the arc is actually burning the higher is the % operating factor.

In India I doubt if the best performance I see is better than 10% operating factor.

So in my opinion, just by using the tools you have in the best and most economical way right now, without changing anything except your view points you could aim at double your output.

X. Summary

To date my stay in India has been rewarding from the standpoint of warm friendships I have made. You have taught me many things (among them patience) and I hope that I have contributed in some small way to Indian technology.

Advice is easy to give, but my advice to you is this :

—Learn all there is to be known about welding from all available sources and examine this knowledge to see if it can work for you.

—Make what you need in welding equipment and make the best.

—Use what you make in the most economical and advantageous way.

—Be innovators. Come up with new ideas for all applications to solve difficult problems.

—Believe in yourselves, be decision oriented, manufacture quality products and take a look at both the home market and export potential.

—Pass around your ideas freely among you. And this IIW forum is one of the best ways to distribute welding knowledge.

And lastly my sincere good wishes for the continual success of the Bombay Branch of The Indian Institute of Welding.