

Welding Technology in the Construction Industry in Botswana

C CHTEREV and J D G FOSTER
Department of Mechanical Engineering
University of Botswana
Private Bag UB 0061
Gaborone, Botswana
Chterev@mopipi.ub.bw; fosterjd@mopipi.ub.bw

Abstract

A survey of companies connected to welding in support of the construction industry in Botswana was conducted by the authors. The method used was a structured interview, supported by a questionnaire. The results show that companies in the industry are generally small, and that the welding technology used is predominantly that of manual metal arc welding. The application of metal active gas welding (MAG) is very limited in comparison with the level of use that is achieved in the industrialised countries of the world. The comparison was used to work out the fundamental directions for further development of welding technology and infrastructure in Botswana. Recommendations are made to assist in the application of modern welding technology in Botswana, which would bring benefits to the construction industry in terms of both cost and quality.

Keywords: *Botswana, CO₂ welding, Metal active gas welding.*

INTRODUCTION TO THE STUDY

Welding technology has obtained access to virtually every branch of manufacturing. Examples include bridges, ships, rail road equipment, building construction, boilers, pressure vessels, pipelines, automobiles, aircraft and power plants.

The importance of welding technology for the construction industry at the present time is unquestionable. It is difficult even to imagine the construction industry operating without application of one or more of the well established welding methods.

New materials (low alloyed high tensile steels, non-ferrous alloys, plastic materials etc.) reach the market almost every year. Their application in the construction industry requires welding technologies that are suitable for the particular application involved.

During last 20-25 years welding technology has developed significantly – from the basic arc or gas methods up to advanced welding methods that use robots and control technology. Engineers and scientists from all over the world are involved in the process of developing welding as a manufacturing process with great potential.

The main directions for utilisation of that potential are:

- To increase productivity
- To improve quality
- To introduce new equipment and consumables
- To remove the operator from dangerous welding zones
- To improve the quality of education and training for engineers and all the other technical staff.

A study was undertaken during 2000 to collect as much as possible information from fabrication and welding companies in the building construction and welding consumables sectors, manufacturing and retail sectors in order to compare the level of welding technology in Botswana with that in the more industrialised countries.

A BASIS FOR COMPARISON

There are different methods for assessing the level of welding technology in a particular country. Our assessment is based on the ratio between manual metal arc (MMA) welding with coated electrodes and another, more productive, method – metal active gas (CO₂) welding, abbreviated as MAG. Descriptions of the latter process are available in standard texts [Davies(1970)][Tashkov (1980)]. The ratio as a criterion is very well recognised and has been frequently quoted in the literature. For example in some industrialised countries this ratio (MMAW: CO₂ welding) is well monitored and Griesheim(1995) and Stahlschlüssel (1995) reported results as follows: Germany 30:70; Sweden 35:65; France32: 68 and Japan 40:60.

There are two major ways of calculating this ratio:

- Based on the consumption of consumables- in our case coated welding electrodes and wire for the CO₂ method.
- Based on the steel structures produced annually applying these two methods.

We have applied the first of these methods, by collecting the following information:

- Consumption of coated welding electrodes for MMA welding.
- Consumption of wires for CO₂ welding.
- Consumption of wires for MIG/TIG welding.
- Number of welding machines for different welding methods as an additional criterion.

THE STUDY IN BOTSWANA

Visits were made to companies that either are producers of structural steel fabrications or are suppliers of products used in the construction industry. The companies were chosen to give a representative spread over construction-related welding in Botswana. The sample included companies specialising in steel-framed buildings, architectural steelwork, reinforced concrete products with welded reinforcement, windows and doorframes.

A standard questionnaire was designed to ascertain the technological processes used by each company: this questionnaire formed the basis of the company interview. No questionnaires were distributed to companies that did not receive a visit.

RESULTS

Results of the survey were as follows:

- Number of companies visited: 11.
- Number of employees in fabrication or welding activities: 5 (smallest) to 50 (largest).
- Respondents stated that the presently established Botswana companies have the necessary capacity between them to undertake all the structural steelwork projects available within Botswana. However, only two of the companies surveyed would normally undertake stainless steel welding, or the welding of light alloys.
- Technology employed included oxy-acetylene cutting and profiling, but not plasma or laser techniques. Whilst the predominant welding method was manual metal arc (MMA), a few companies were equipped to apply metal active gas (CO₂) welding, but claimed that the use of it in structural steelwork was mainly still at the experimental stage for them (this is in contrast to the use in automotive repair shops and steel furniture, where the technology is well accepted). Use of tungsten inert gas (TIG) welding was confined to two only of the firms surveyed, and resistance welding (spot welding and flash-butt welding) was only found in the building products companies.

We have summarised the trend of typical responses in Table 1, but it should be emphasised that the data was generated by the user companies themselves, and we were not able to obtain corroboration from the welding equipment suppliers for commercial reasons. This data must be considered as an initial attempt to characterise the level of welding technology in the service of the Botswana construction industry, and, as we note under our recommendations at the end of this paper, there is scope for a much more thorough quantitative analysis. In particular, the estimated national numbers of companies given below can only be an approximation based on the authors' observations of activity town-by-town.

Group	Monthly consumpn of MMA electrodes (kg)	Number in this group In survey/ in Botswana (est.)	Wire for MAG As % of MMA Electrodes (average response)	Number of welding Machines (average)	Machines for MAG as % of total (ave)	Machines for TIG as % of total (ave)
Medium Cos.	>100	3 / 20	2%	20	12.5%	7.5%
Small Cos.	20 - 100	3 / 60	0	6	0	10%

Table 1: Ratio of Welding Methods for Medium- and Small- Sized Companies

- Training of welders, boilermakers and other welding trades was undertaken by all companies principally on an 'on the job' basis.
- When asked to state their sources of technical advice on welding processes, most companies stated that they relied on information from the suppliers of welding consumables and equipment. However, the suppliers themselves felt that such advice as they offered was very rarely followed.
- Based on the interviews, there was evidence that the designers of steel structures are not well informed as to the possibilities and limitations of welding processes.
- Engineers inspections of weldments used in construction were generally limited to fit and visual appearance. Quality control by the client or architect of the material and the welding process applied was reported to be absent on most jobs.

GENERAL COMMENTS CONCERNING THE RESULTS FROM THE SURVEY

A Materials

- 1) In the construction industry of Botswana local companies are organised and equipped mainly for fabrication in low carbon steels, in other words for the use of low quality steels.
- 2) Alloyed steels (including low alloyed high strength steels) are rarely used.
- 3) In most of the cases if it is necessary to produce metal structures from non ferrous metals and their alloys or from alloyed steels South African companies are invited to do the job. This is quite understandable due the level of welding technology in Botswana.
- 4) All the welding consumable are imported from South Africa (RSA) or overseas.
- 5) With very few exceptions, all metal products are imported from RSA or Zimbabwe, but the original source is usually not certified and may even be disguised.

B Welding Equipment

- 1) All the necessary equipment is imported, mainly from RSA.
- 2) Maintenance of the equipment is directed to SA companies.
- 3) There is a shortage of technical staff for maintenance.
- 4) The existing equipment is mainly for MMAW. There are welding machines for MIG/TIG and other methods but practically they are not used or are still in an experimental stage of application.

Further observations

To the above results of the survey, the authors would add the following observations, based on experience in several countries:

Training Issues

- 1) Highly specialised courses for technicians in field of welding are not available in the country at this stage.
- 2) The University of Botswana is not yet in a position to offer a Masters programme in Materials Technology.
- 3) There is no well developed national system for training and registration of welders according to the international standards.
- 4) There is a shortage of qualified lecturers and instructors in field of welding.

Standards and Quality Control Issues

- 1) Although the welding industry has been consulted by the Botswana Bureau of Standards in connection with liquefied petroleum gases (LPG), the process of creating national standards in the field of welding has not started yet.
- 2) There is no established procedure or national infrastructure for quality control in welding – for example welding of pressure vessels etc.

RECOMMENDATIONS AND PROPOSALS

- 1) A more detailed study of the overall size of the industry in Botswana, and of the size distribution of companies using welding technology, should be undertaken. Companies that might be expected to have such information may regard their market research as commercially confidential, and therefore indirect methods may have to be employed. For instance, it is thought that some estimate of the total market size could be reached by using customs data for the tonnage of steel imported,

together with data from international studies that give figures for the likely ratio of welding materials to steel used in the construction industry.

- 2) An association, with the suggested name Botswana Welding Society (BWS) should be founded. The BWS could affiliate to the existing Botswana Institution of Engineers.
- 3) Under the umbrella of the Botswana Bureau of Standards (BOBS) the introduction of national system of standards in field of welding should be begun.
- 4) UB-FET to consider the implementation of specialised courses for degree programme students in field of welding and short courses directed to industrial needs for practising engineers and technicians.
- 5) A way should be found to ensure that craft trainees and practising welders in all industries gain experience of advanced methods of production that employ modern welding technologies. This might be done by means of a project to enhance the technical capacities of welding training schools run by the Ministry of Home Affairs, Ministry of Education and commercial companies.

ACKNOWLEDGEMENT

The authors wish to thank the staff of the responding companies, who were kind enough to share their views and certain company data with us. It is hoped that representatives of some of these companies may be able to attend the presentation of this paper, and thus to contribute to any subsequent discussion.

REFERENCES

- 1) Davies, A C (1996) *Welding* (10e), Cambridge University Press, pp 434-474.
- 2) Messer Griesheim (1995) *Schweissen and Schneiden* Report from group sponsored project No. 4 pp 9-12, Frankfurt.
- 3) Tashkov, Iankov and Bakardjiev (1998) Productivity of CO₂ method in comparison with manual metal arc welding with coated electrodes, *Gas Shielded Metal Arc Welding* (2e) pp 233-239, Technika, Sofia 1998.
- 4) Wegst, C.W. (1995) *Stahlschlüssel*, annual edition 1995 pp 85-86, Marbach.