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FIELD WELDING OF STEEL GIRDERS FOR BRIDGES

ДІЛЯНКА ЗВАРЮВАННЯ СТАЛЕВИХ БАЛОК ДЛЯ МОСТІВ

ЗОНА СВАРКИ ЖЕЛЕЗНЫХ БАЛОК ДЛЯ МОСТОВ

Annotation. Study about welded plate girder where the shape design of welding joint, effected on the cost of manufacture and also welding procedure and alloy element effete and type of welding machines. and the preheating controlled interpasstempratuers and some times even controlled heat input from the welding procedure to rated the cooling rate and reduce shrinkage stresses.

Keywords. Welding, shrinkagestress,girder, temperature, bridge.

Анотація. В роботі розглянуті питання розробки і застосування нової методики зварювання великих сталевих балок конструкцій мостових переходів. наведена інженерна технологічна процедура зварювання, яка може бути застосована до штатних мостів типовим зварювальним апаратом.

Ключові слова. Зварювання, напруга усадки, балка, міст.

Анотация. В работе рассмотрены вопросы разработки и применения новой методики сварки больших стальных балок конструкций мостовых переходов. Приведена инженерная технологическая процедура сварки которая применима к штатным мостам типовым сварочным аппаратом.

Ключевые слова. Сварка, напряжение усадки, балка, температура, мост.

Introduction

In butt groove welding the ends of flange plates, some thought should be given to the proper type of joint. J and U joints require the least amount of weld metal; however, these joint types generally require the plates to be prepared by planning or milling which is impractical in most structural fabricating shops. This limits the preparation to flame beveling, giving a V joint.

In the V joint, less weld metal is necessary as the included angle is decreased. However, as this angle decreases, the root opening must be increased, in order to get the electrode down into the joint, and produce a sound weld at the root of the joint. Obviously, the one tends to offset the other slightly in respect to the amount of weld metal needed. On thicker plates, the joint with the smaller included angle and larger root opening, requires the least weld metal.

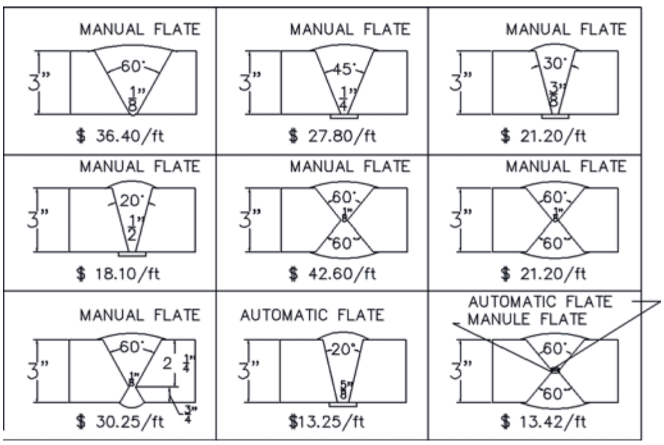

Figure 1. Relative cost of flange butt welds

If a backing strap is used, any amount of root opening within reason can be tolerated, and all of the welding must be done on the same side; in other words, a single -V joint. If a backing strap is not employed, this root opening must be held to about 1/8». This enables the root pass to bridge the gap and not fall through. The welding may be done on one side only, single-V; or it may be done on both sides, double V. In either case, the joint is back-gouged from the opposite side to the root before depositing additional weld metal on the other side. This will insure sound metal throughout the entire joint.

Single-V joints may be acceptable if the plates are not too thick; for thicker plates, double-V joints are preferred since they require less weld metal. Remember that a single-V joint will produce more angular distortion. This increases rapidly as the flange thickness increases.

Shop Splicing

Shop splices in flange and web plates should be made before the girder is fitted together and welded, pro¬viding the resulting sections are not too long or heavy to handle. These shop splices do not have to be in a single plane, but are placed where they are most con-venient, or where a transition in section is desired.

In the shop, flange plates can be turned over easily as welding progresses, so that on thicker plates double -V joints would be used. They require the least amount of weld and the welding is balanced so there should be on angular distortion. On wider plates perhaps 2' to 3', semi-automatic and full automatic submerged-are welding equipment is frequently used.

Field Splicing

Field splices usually are located on a single plane. Staggering the butt welds of flanges and webs will not improve performance of the girder. It is much easier to prepare the joints and maintain proper fit-up by flame-cutting and beveling when all are located in the same plane. See Figure 2. There is an advantage to having extended the fillet welds of flanges to the web all the way to the very end of the girder. This provides better support when the flanges are clamped together for temporary support during erection.

Most welding sequences for field splices of beams and girders are based on the following general outline.

Figure 2. Three methods of preparing edges of girders for field welding. Placing the three welds in three different planes makes it difficult to get close fit. It is easier to lay out all three butt welds in same plane. Placing two flange welds in the same plane and slightly offsetting the weld in the web offers a method of sup¬porting one girder on the other during erection

In which both flanges and web are alternately welded to a portion of their depth, after securing with, sufficient tack welds; see Figure 3.

1. Weld a portion of the thickness of both flanges (about 1/3 to 1/2), full width.
2. Weld a portion of the thickness of the web (about 1/2), full width.
3. Complete the welding of the flanges.
4. Complete the welding of the web.
5. For deep webs, the vertical welding is sometimes divided into two or more sections, and a back step method is used; Figure 4. This will result in a more uniform transverse shrinkage of this joint.

Most butt joints used in field splicing the webs are of the single-V type. For thicker webs, perhaps above 1/2», a double-V joint is used in order to reduce the amount of welding required and to balance the welding about both sides to eliminate any angular distortion.

Most flange butt joints to be field welded are either the single-V or double-V type, depending on the flange thickness and the method of welding used. For higher welding speeds, such as when using iron powdered manual electrodes, or semi-automatic, or fully automatic submerged-arc welding, more of the welding would be done in the flat position, with less in the overhead position.

It must be remembered that a single-V joint will result in more angular distortion and this increase rapidly as thickness increases.

A double-V joint with half of the welding on both the top and bottom of the joint is best as far as distortion is concerned, but it may require a considerable amount of overhead welding for this reason the AWS Prequalified Joints allow the double-V joint to be prepared so that a maximum weld of 3/4 of the flange thickness is on top, and the remaining 1/4 on the bottom; see Figure 5.

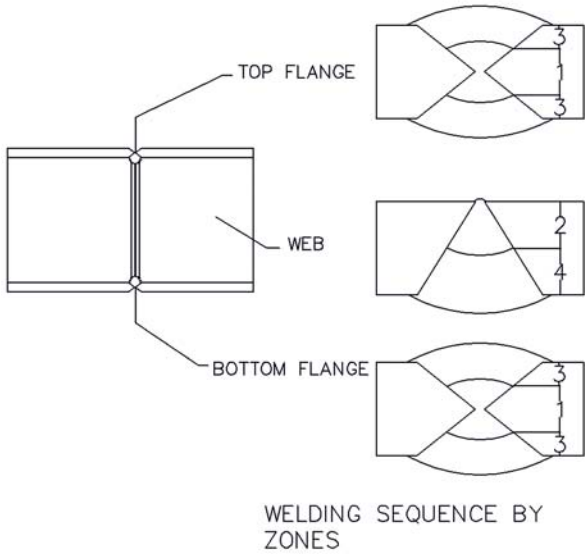

Figure 3. Both flange and web are alternately welded

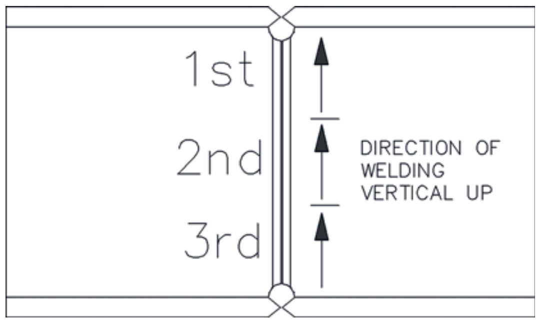

Figure 4. For deep webs use back – step sequence

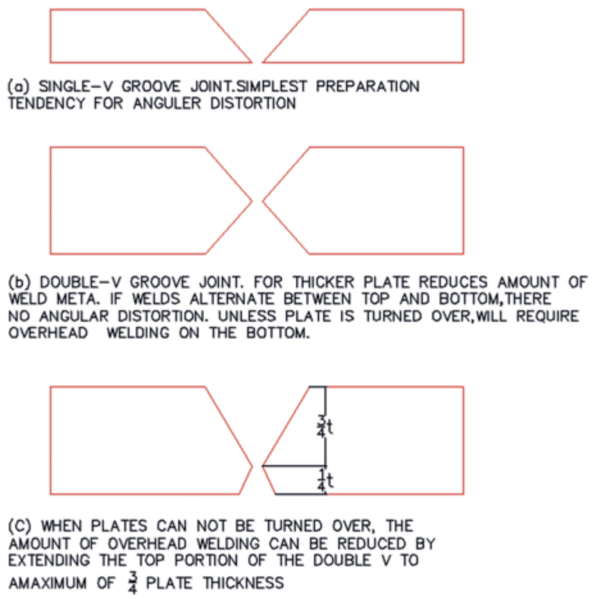

Figure 5.

reduce the amount of overhead welding.required (lbs/ft of joint) for the various AWS prequalified Joints. This will aid in making a better choice of the actual details for the best overall joint. For the double -V butt joint for the flange, the state of Texas allows the field weldor to place the overhead pass in the bottom side of the joint first, and then after cleaning the top side to place the next pass in the flat position. Their thinking is that while some overhead welding is needed regardless of the sequence used, this procedure eliminates all of the back chipping or back gouging in the overhead position. If the welding is done properly, there should be less clean-up required.

Proper fit-up

Good fit up is essential to the development of efficient welding procedures. This means proper alignment and correct root opening.Placement of flange and web butt splices in the same plane greatly increases the ability to achieve correct root opening when the girder is pulled into alignment.

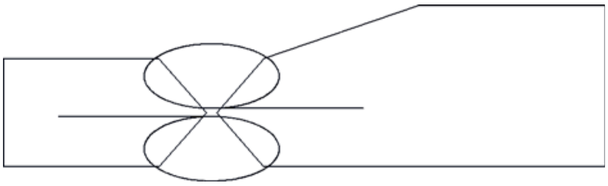

Figure 6.

Figure 6 illustrates a misaligned double-V butt joint in a girder flange at the point of transition.Note the offset of the joint preparation makes it difficult to reach the root of the joint and deposit a sound weld throughout the entire joint. The flange joints should be checked for alignment throughout their entire length beforewelding.This illustrated condition can exist at the flange extremities even though perfect alignment exists in the web area. Accidental tilt of the flanges during fabrication, mishandling during movement to the job site, or even a difference in warpage of the two flanges can cause this condition. The warpage problem in creases with the size of web-to-flange fillet weld and decreases as the flange thickness increases.

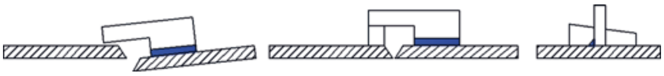

Figure 7. Weld clip along one edge only so it may be removed easily with a hammer. Drive steel wedge below clip until plate edges are in alignment

Various methods exist for correcting this condition. Figure 7 illustrates one such method. When the plates are not too thick, small clips can be welded to the edge of one plate. Driving a steel wedge between each clip and the other plate will bring both edges into alignment. Welding the clips on just one side greatly simplifies their removal.

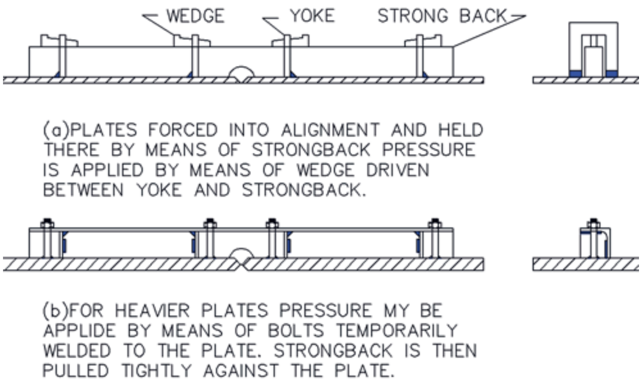

Figure 8.

Figure 8 illustrates still another method which is used commonly when problems develop in respect to misaligned thicker flanges. Here (top sketch) a heavy bar or strong back is pulled up against the misaligned plates by driving steel wedges between the bar and attached yokes. An alternate method (lower sketch) involves the welding of bolts to the misaligned plate and then drawing the plate up against the strong back by tightening up on the bolts.

Base Procedeure On ActualeAnalysis

Published standard production welding procedure generally apply to normal welding conditions and the more common «preferred analysis « mild steels when a steels specification analysis falls out side the preferred analysis, the user often adopts a specials welding procedure based on the extreme of the materials chemicals content «allowed» by the steel specifications however,since the chemistry of specification heat of steel may run far below the top limit of the «allowable» a special procedure may not be required or may required only a slight change from standard procedure and thereby minimize any increase in welding cost. For optimum economy and equality, under either favorable or adverse condition the welding procedure for joining any type of steel should be based on the steels actual chemistry rather than the maximum alloy content allowed by the specification. these is because a milles average production normally runs considerably under the maximum limit set by the specification. see table (1)

Usually a mill test report is available which gives the specific analysis of any given heat of steel once this information is obtined, a welding procedure can be set that will assure the producation of crack free welds at the lowest possible cost.

Table 1.

Preferred analysis of carbon steel for good weld ability

Element		Normal range, %	Steel exceeding any one of the following percentages will probably requires extra care
carbon	C	0.06 – 0.25	0.35
manganese	Mn	0.35 – 0.80	1.40
silicon	Si	0.10 max	0.30
sulphur	S	0.035 max	0.050
phosphorus	p	0.030 max	0.040

Conclusions

Shape of welding joint effected on the cost of join as show in Fig.1 and however when welding the thecker plates in even these steels the incresedrighdity and restraint and the drastic quench effect makes the use of the proper procedure vitally importint in addition, thick plates usually have higher carbon content.

And also have an incresas in the use of higher strength low alloy steels theses steels have some elements in there chemestry that execeed the ideal analysis, tabel(1) for high speed welding, and proven welding proceder are requierd to assure the production of crack free weld when joining thecker plates or the alloy steels.

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