A Flange To Shell Weld —A Distortion Study

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1. INTRODUCTION

Recently we fabricated a Raw Mill for a Cement Plant. (Ref. Fig 1).

Therein we came across heavy distortion of flange while welding was only partially done. At this stage, we changed the earlier proposed welding procedure and sequence to compensate the distortion and bring the flange within the machining tolerances.

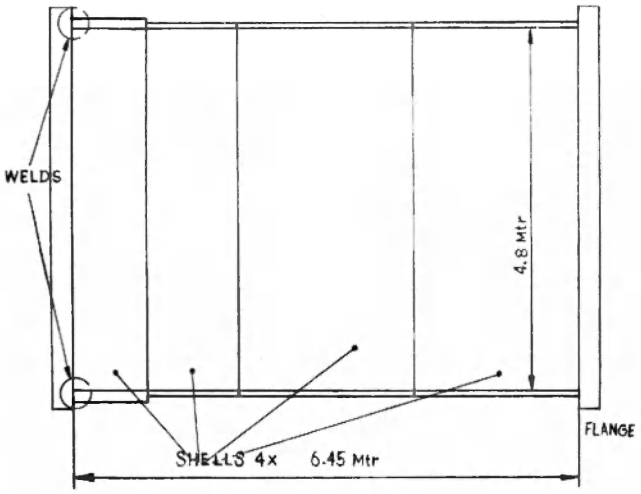

Fig. 1. Flange to shell construction.

The author is with Walchandnagar Industries Ltd., Walchandnagar. This paper was presented at the one-day conference organised jointly by IIW, Bombay and WIL on 23/10/83.

1.1 The Shell

I.D. 4.8. mtr., thickness 89 mm.

1.2 The Flange

Flange is made by welding sectors together (Thickness 190 mm)

1.3 Material Specifications

IS 2002 Gr II-A for both

2. WELDING STAGES

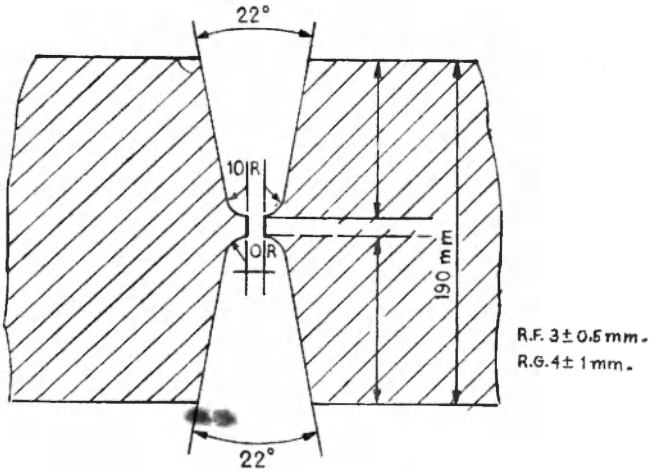

Fig. 2. Flange butt weld.

2.1 **Welding of flange sectors (Ref. Fig. 2)**

Welding Process (SMAW + SAW)—

(i) In the beginning, a few passes of SMAW were given and then 60% of groove was filled up with SAW.

(ii) Root gouging/grinding upto sound metal and then a few passes of SMAW were given and then full SAW was done.

(iii) Remaining SAW of face side was then completed.

3. FLANGE MACHINING (Ref. Fig. 3)

4. SET UP OF FLANGE TO SHELL JOINT (Ref. Fig.4)

4.1 **Welding Procedure**

Before welding, fifteen bridge tacks of one inch thick plate were given across the inside groove, at a distance of one metre each.

The fillet size was approx. 15 mm. Tacking was done after local preheat.

5. WELDING SEQUENCE

5.1 Preheat the whole joint to 200°C.

5.2 Then adopt SAW upto full groove build up.

5.3 Interpass temperature not to exceed 300°C.

5.4 Root gouging/grinding upto sound metal.

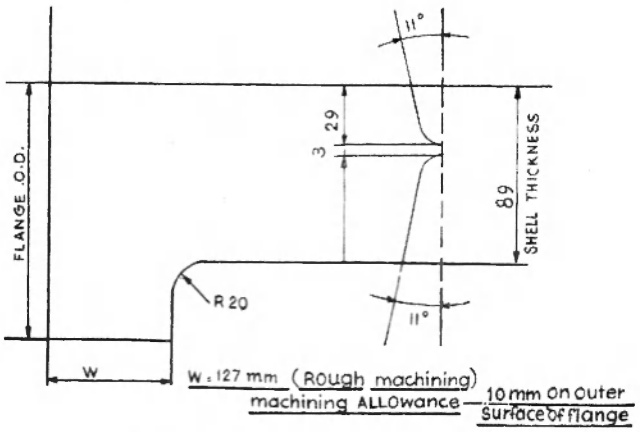

Fig. 3. Flange edge preparation.

5.5 Then SMAW + SAW or SAW upto full groove built up from inside.

Accordingly, welding was started from outside by using SMAW first. After completing 5×SMAW runs, SAW was started.

6. DISTORTION

6.1 At intermediate stage (approx 40 mm groove build up was completed) it was observed that flange had warped towards shell by about 15 mm, while the machining allowance on the face side (outside) of flange surface was only 10 mm. Therefore, it was necessary to rectify this and bring it within the machinable dimensions as well as to avoid further damage by distortion.

6.2 **Modified Procedure**

Hence it was decided to stop the welding on the outside groove at that stage only. Then to compensate the distortion it was proposed to complete inside welding first.

Accordingly,

(i) Root gouging and DPT from inside was carried out and

(ii) With a preheat of 200°C, welding started. Instead of earlier choice of either SMAW+ SAW, or SAW, the second option of SAW enforced. This helped us to fill up the groove in a continuous manner without interruptions.

After completing the inside groove welding, it was observed that the distorted flange had regained the position within the machining tolerances.

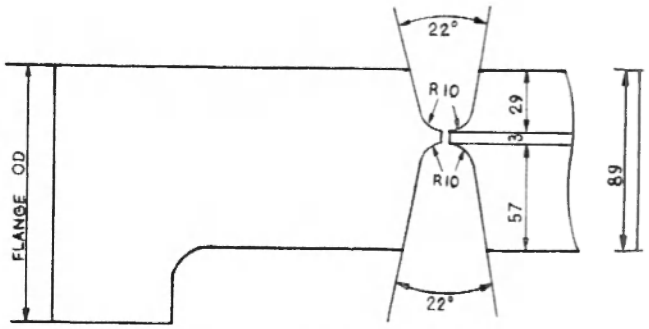

Fig. 4. Flange to shell weld set up.

Then remnant part of outside welding was completed by SAW, which did not affect the distortion position adversely.

6.3 The final distortion prior to machining was 3 mm. i.e. the outermost surface of the flange showed warpage towards shell side by approx 3 mm and the machining allowance left was 7 mm, which was good enough.

7. CONCLUSIONS

7.1 Stiffness/bridge tacks given from inside may not have been strong enough due to which some stiffener welds had cracked.

7.2 Uniform preheating temperature was not possible due to large diameter and few single point burners.

7.3 Interrupted welding/preheating during lunch break, power failures etc. would have caused the problem.

7.4 A continuous monitoring of the distortion features helps to give a timely warning and a judicious sequence/change in welding progression can help to avoid problems and correct the situation in proper time.

7.5 Distortion and warpage are very important side effects of any welding and even in large fabrications the same need to be watched with care to work within the machining allowances.

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