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Development Of New Bending Tool To Bend Zero Offset Bends

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Abstract*: Development of Bending Tool for Reducing Inter Mediate Length (IML) between the offset bend. The minimum length is requiring between the centers of the bend tool and bending machine is 350 mm. So, we cannot bend our sufficient degrees and length. In order to solve the defects, we change the bend die as per our convenience for reducing length. It is non-standard .This modified bend die's advantage is to bend 0-0 degree as well as reduce the Inter Mediate Length (IML) .For this success , we modified the components of bending machine (Bend die, Clamp die) . It is very useful to lower bend without changing other bending machine. This machine is called Rotary draw bending machine. It contains four components- Benddie , Pressure die , Clamp die, Mandrel. Bend die , Pressure die , clamp die were modified as per our required diameter which is used in burner panel.*

Keywords: *Herber bending machine, bending die, clamp die, pressure die.*

I. Introduction

Bending process by that metal are often unshaply by plastically deforming the fabric and ever changing itform. Bending typically refers to deformation regarding on axis. The fabric is stressed on the far side the yield strength however below the final word strength. The Bending diagram as show in fig 1.1.

Bending may be versatile method by that may be various different shapes are often made. Normal dies sets area unit wont to turn out a good type of form. The fabric is placed on the die, and positioned in situ with stop and/or gages. It's control in situ with hold down.

The higher a part of the press, the ram with the fifty formed punch descends and from the formed bend.

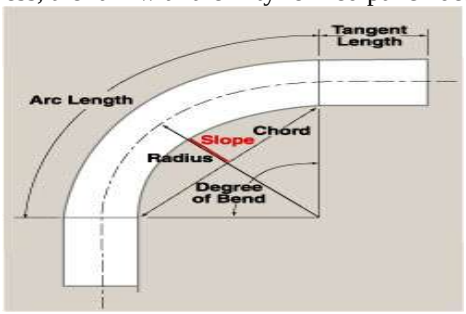


Fig 1.1 Bending Processes

Bending is completed victimization press brakes. Press brakes usually have a capability of 20 to 200 tons to accommodate stock from 1m to 4.5m (3 feet to 15 feet). Larger and smaller press square measure used for specialize application. Programmable back gages, and multiple die sets out there presently will play a awfully economical method.

II. Literature Review

Mr.Brazier, et al-2005 In the past, researchers have worked on cross section distortion, wall thickness variation, and wrinkling issues related to pure bending of tubes. studied the distortion of round tubes in elastic bending using energy minimization. Named after Brazier's work, the cross section deformation in tube bending is often called the Brazier effect.

Mr.Zang and Yu, et al-2000investigated the Brazier effect of an infinitely long, cylindrical tube under pure elastic-plastic bending. Expressions of bending moment and flattening ratio in terms of radius of curvature were obtained.

Mr.Pan and Stelson, et al 2006Considering a finite length tube, used energy method to solve for the distortion shape and wall thickness variation of plastically deformed tubes

.**Mr.Wang and Cao,** et al 2001studied wrinkling in tube bending with boundary restriction at the ends. An energy method was used to determine the critical bending radius at the onset of wrinkling as a function of tube dimensions, tooling geometry and material properties. With the advancement of computational mechanics, the finite element method has been used to simulate tube bending process.

Mr.Tarana, et al 1998conducted simulations of rotary draw bending and tube hydroforming processes. The influence of bending operation on hydroforming was demonstrated. With changes in loading condition, tubes under stretch bending behave differently from those under rotary bending.

III. Herber Bending Machine

Herber Engineering AB has been manufacturing cold forming machinery for tube and pipe since 1945 and with virtually 70 years of expertise is recognized worldwide united of the premier marker and largest producers of booster bending machines specifically design for the precise needs of the boiler trade.An energy method was used to determine the critical bending radius at the onset of wrinkling as a function of tube dimensions, tooling geometry and material properties. With the advancement of computational mechanics, the finite element method has been used to simulate tube bending process.

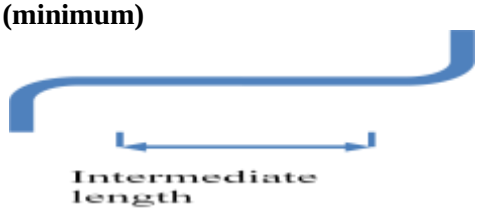
Fig 3.1 Herber bending machine

3.1 Problem Scenario

The new tower type boiler has been designed with burner panel with complicated bends. Pre-production study was conducted and it was found that these bends could not be done with conventional bending machines.

The multi plane offset bend could not be bent in the conventional bending machine.

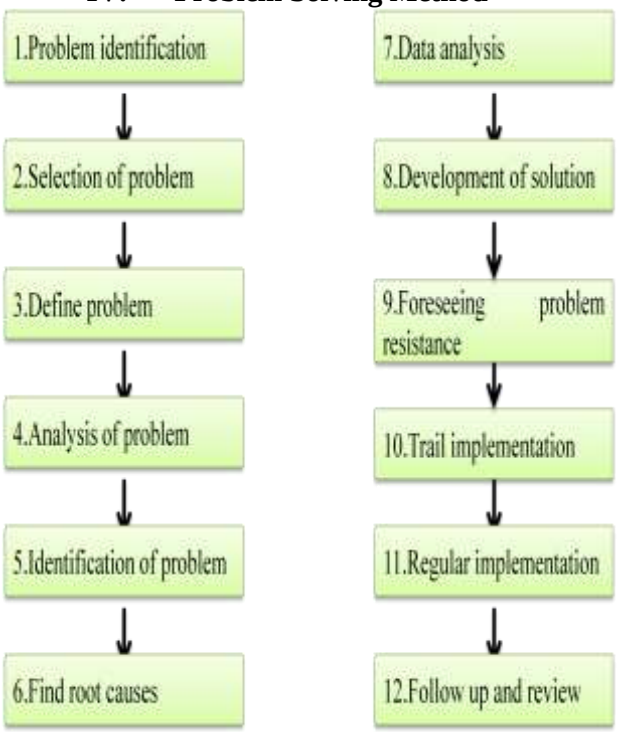
IML that can be bent –**350 mm (minimum)**



IML required **- ZERO**

It was decided to introduce manual TIG joints between bends but the cycle time for completion of the bends with TIG joints were very high and the work required more skilled manpower complete the job.

IV. Problem Solving Method



4.1 Defining The Problem

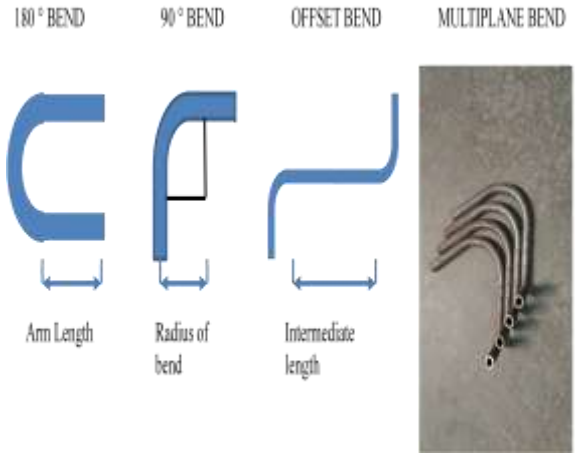


Fig 4.3 defining the problem

The new tower type boiler has been designed with burner panel with complicated bends. Pre-production study was conducted and it was found that these bends could not be done with conventional bending machines.

It was then planned for identifying vendors for completion of these critical bends and it was found none of the vendors had the capacity to bend the tubes.

A.Goal And Objectives

- To improve Machine Capability
- To Improve Safety
- To Improve Ease Of Work
- To Reduce Production Time
- To Reduce Man-Hour

- To reduce TIG joint.

4.2 Analysis Of Problem

What Is The Problem?

Cycle Time of Burner Panel Assembly Is More.

Where Is The Problem?

In Burner panel assembly shop

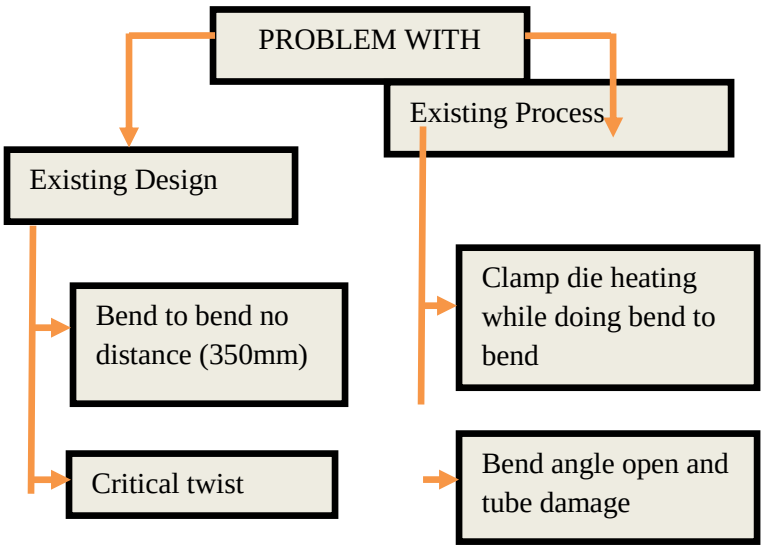
When?

While Preparing Bends for Burner Panel

Who Is Facing The Problem?

Bending & Manual Tig Welding Operator

4.3 Developing Solution



A. Developing Solution Drawing

Fig 4.1(i) Old former die

Fig 4.1 (ii) New former die

Fig 4.2 (i) Old clamp die

fig 4.2 (ii) New clamp die

4.4 Follow Up And Review

Data collection for power consumption of crane and welding machine and man hour		
BEFORE QC	AFTER QC	SAVED
CRANE USAGE FOR BENDING AND TUBE POSITIONING		
Power consumed for positioning = 34.451 kw hr= 68.902 kw hr/day = 1722.55 kw hr/month =20670.6kwhr/year	Power consumed for positioning = 18.52 kw hr = 37.04 kw hr/day = 926kwhr/month = 11112kwhr/year	=31.862kw hr/Day =796.5kw hr/Month =9558.6kw hr/Year
CHAMFERING AND WELDING TUBE JOINT AND FIT UP		
Power consumed (10bends &tig joints) =6.32 kw hr =12.64 kw hr/day = 316 kw hr/month = 3792 kw hr/year	Tig joint totally eliminated = 0 kwhr	= 0 kw hr
	TOTAL POWER SAVING =**13350.6 kw hr/year**	
MAN HOUR		
Man hour using (BENDING & TIG) =15.6hours/day =405.6hours/month =4886hours/year	Man hour using (BENDING) =2.3 hours/day =59.8hours/month =717.6hours/year	MAN HOUR SAVING 4149.4 hour/year

V. Material And Experimentation

A.Section Of Material

- Hardened carbon Steel or Alloy steel.
- Heat treated and hardened dies are 60 HRC.
- The Standard material is SA 299.

SA-299 Grade B Standard Number		
Item	Standard Number	Descriptions
1	SA-299/SA-299M	Pressure Vessel Plates, Carbon Steel, Manganese

Chemical Composition

Grade	The Element Max (%)					
	C	Si	Mn	P	S	Mo
SA299 GR.A	0.28-0.30	0.13-0.45	0.84 - 1.62	0.035	0.035	-
SA299 GR.B	0.28-0.30	0.13-0.45	0.84 - 1.62	0.035	0.035	-

B. Experimentations

- cut the block from the gas cutting.
- Gas cutting diameter for 360mm.
- After turning the lathe for both side facing and plain turning.
- Step down set turning for 90mm.
- After that marking groove and centre line of hole.
- Move to vertical milling machine using end mill cutter grooving as per marking.
- Move to drilling machine to drilling for 14mm hole.
- After marking a tapping operation for 10mm at bottom face.

C. Calculation Of Tube Bending:

MATERIAL: SA-299

Outer Dia of the tube = 38.1 mm

Inner dia of the tube= 24mm

Geometry Parameter

K=R/2r

K= 45/19.1*2

K=1.18

MOMENT OF INERTIA

I= 1.41+0.42/1.18

I=1.76 mm^4

SECTION MODULUS

W = □/32 (D^3-d^3)

= π/32($38.1^3 - 24^3$)

W=4072.51 mm^2

BENDING MOMENT

M= □s *Wb*J

T= π/16*D^3* σs

148000= π /16*38.1^3*

σs = 13.62 N/mm^2

M= σs*Wb*J

= 13.62 *4072.51*1.76

M = 97622.95 N-mm

Bending Moment for boosting clamp

M= Fb * R

Fp=P*A

Fb= 400 * 10^2*π/4*38.1^2

Fb = 45603673.12 N

Mb= 45603673.12 * 45

Mb = 8.61909 * 10 ^10 N-mm

Bending moment of pressure die

Mp=Fp *D

P=Fp/A

Fp=18000*π/4*38.1²

Fp = 20521.625 N-mm

Bending Moment of Wiper Die

Mw= M+M* (50/100)

= 97622.95 + 97622.955 (50/100)

Mw = 66965.46 N-mm

Bending Moment of Mandrel

Mm= M + M* (50/100)

Mm= 66965.46 N-mm

Total Bending Moment

Mmax =M+Mb+Mw+Mm

= 97622.95 +(8.61909* 10¹º) + 781873.91 + 66965.46 + 66965.46

Mmax = 86191.913 * 10^6 N-mm

Mmin =M-Mb-Mw-Mm

= 97622.95 – (8.61909 * 10^10) -781873.91 - 6695.46 - 66965.46

Mmin = -86191.45 * 10 ^6 N-mm

VI. Result& Discussion

A.Old bending process

Shift :General Shift	Time : 8.00 - 16.30
Bending process – 03Tig welding process	
01, Crane Operator – 01	Fitter – 02, Welder

SL.NO	PROCESS ACTIVITES	TIME IN MIN
1	Loading Tube On Stand And Checking	20
2	Former Change	40
3	Marking Tubes	20
4	Programming	10
5	Tube Bending	50
6	End Chamfering & Fit up	200
7	Tube Tig Welding	600
	Total	940

Total Process Takes 940 Minutes

B.New bending die

Shift :General Shift	Time : 8.00 - 16.30
Bending process – 03Tig welding process	
01, Crane Operator – 01	Fitter – 02, Welder

SL.NO	PROCESS ACTIVITES	TIME IN MIN
1	Loading Tube On Stand And Checking	20
2	Former Change	40
3	Marking Tubes	10
4	Programming	10
5	Tube Bending	50
	Total	140

Total Process Takes 140 Minutes

Advantages of bend die

- ✓ To reduce working time.
- ✓ To reduce cost.
- ✓ To reduce man power.

- ✓ Multiple bend have been possible.
- ✓ To reduce intermediate length (IML) in an offset bend.

Applications

Through this specified bend tool, zero to zero bend is possible. This bend is used in multiple sections in burner panel

Fig 6.1 continuous bending

VII. Conclusion

Finally, if the bend die is tied with bending machine when bending, use left hand (Anti-clockwise) machine is possible. In order to avoid this, Bend die should be modified for our convenience requirement. Semi-circle bend die should is solve the above defect .It is non-standard. It is very useful to 0-0 bend and reduces the Inter Mediate Length (IML) between the offset bend. It will reduce working time.

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