Research Article

Lack of Penetration of Welded Pipe and Stress Behavior

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ABSTRACT

Use of too low a welding current, the practical use of too slow a travel speed, and an incorrect torch angle, in common are the most effects can cause penetration defects In this methodological study, we will do some analyses of stresses concentration on welding throat area on Pipe manufactured by API 5l X52 material and carefully compare necessary results between a good welded pipe and another one lacked from penetration; for that we typically apply five different pressures to naturally limit the desired results, this numerical study reasonably requires using SOLIDWORKS for ultimate conception and launch simulation with ANSYS after importing the specific geometry.

Keywords: *Pipelines, welding, lack of material, welding throat*

1.INTRODUCTION

Pipelines realistically are the veins of modern cities and modern towns. They knowingly transport drinking water, gas, oil and much, much more for that, pipe welders are needed to wisely keep them working properly. They undoubtedly play a big role in the petroleum industry, working on the piping necessary for each step of the process of bringing gas to the pump: from the oil rigs that carefully extract the crude to the direct pipelines that transport it to the refineries that turn it into oil and gas [1].

Arc welding is taking two or more separate pieces of metal and joining them into one continuous or homogeneous section. We achieve coalescence, which means to blend or come together. In other words, the purpose of arc welding is to achieve fusion between the initially separate pieces of metal. The American Welding Society (AWS) defines fusion as "The melting together of filler metal and base metal (substrate), or of base metal only which results in coalescence" (ANSI/AWS A3.0 Standard Welding Terms and Definitions). Fusion occurs when you have atomic bonding of the metals.

The molecules of each separate piece of metal and the filler metal bond together when you have 1) atomic cleanliness and 2) atomic closeness (see Figure 2). This occurs with the arc welding such that the atoms of each piece of metal bond together with shared electrons to become one solid or homogeneous piece of metal [2].

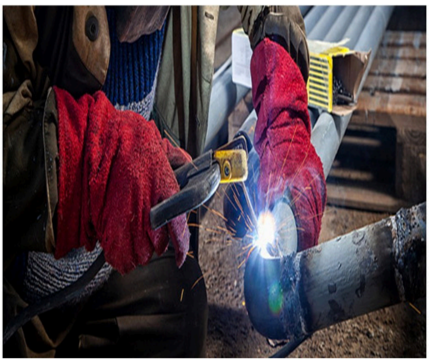


Figure 1. Pipe welding

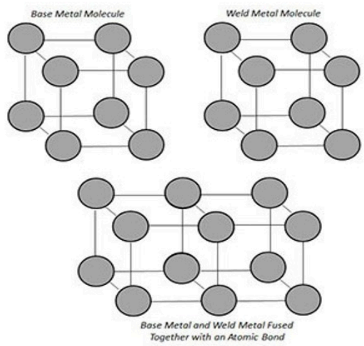


Figure 2. Atomic Bonding

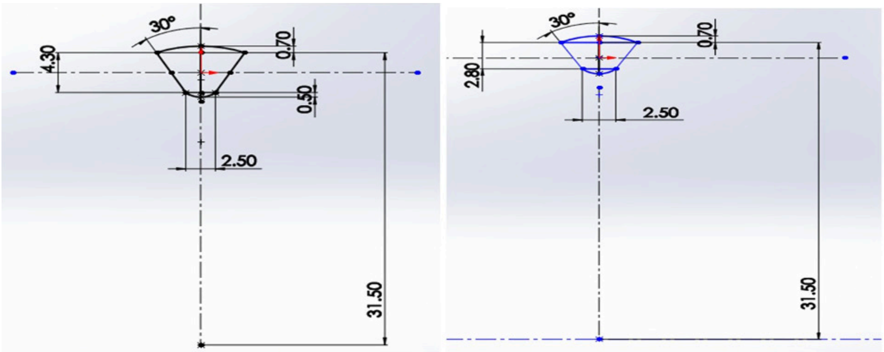
2. CONCEPTIONS

Depending on the on Table 1 we design our geometry:Table 1:

Table 1. Dimension of Parts

Parts	Dout (mm)	Din (mm)	Th (mm)	Chamfer (°)
Pipe	63	54.40	8.6	30
weld joint	63+0.7	55	11	30

To create our defect, we will play on allowance of weld joint (Figure 3).



THE PERFECT WELDED JOINT **THE DEFECTED WELDED JOINT**

Figure 3. The two different joints used

The next figures show all parts in 3D (Figure 4, Figure 5) …

Figure 4. The pipe

Figure 5. The welding joint

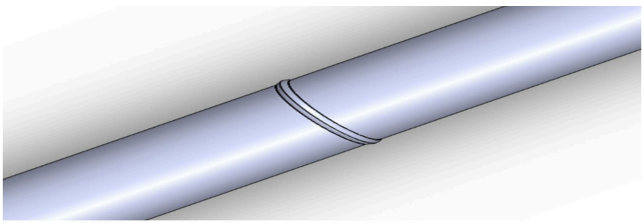


Figure 6. The welded pipe

After conception we and assemble parts (Figure 6) we define the two models of our study (Figure 7, 8).

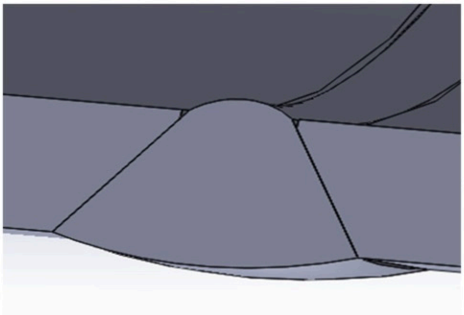


Figure 7. First model: Perfect welded joint

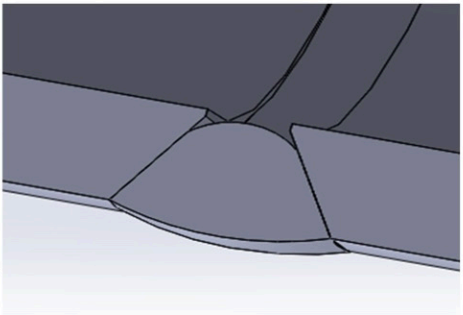


Figure 8. Second model: the defected welded joint

3.SIMULATIONS & RESULTS

For simulation we choose API 5L X52 Steel (look **Table 2**)

Table 2. Mechanical properties of the three zones

Zone	E (Mpa)	σYS (Mpa)	σUTS (Mpa)
BM	206.850	391.97	591.02
HAZ	206.850	363.01	616.20
WB	206.850	385.83	601.15

Here some Figures show Von Mises stresses for the two models after applying 50 MPa of pressure.

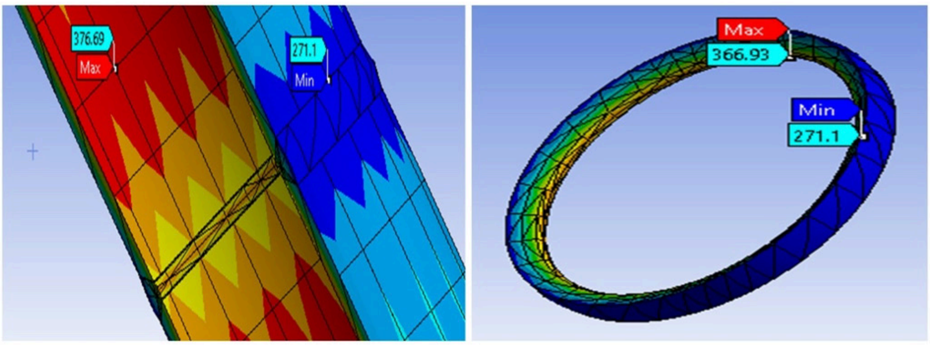


Figure 9. σ_{max} and σ_{min} model 1

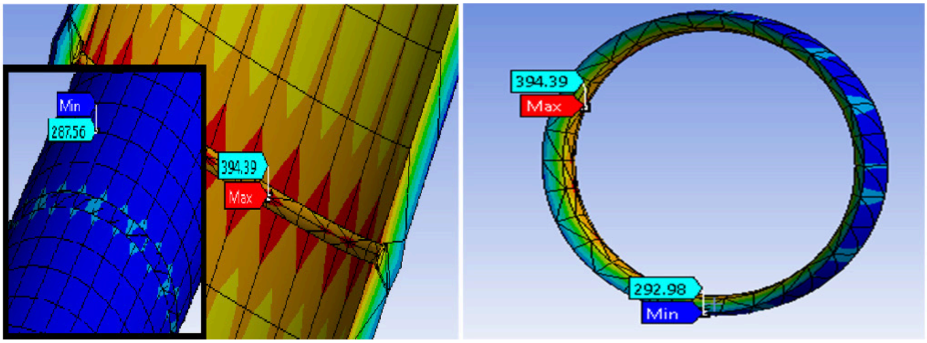
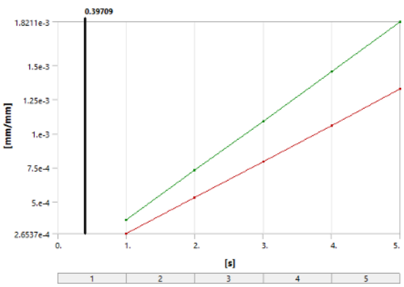


Figure 10. σmax and σmin model 2

Table 3. Stresses results with 5 different pressures for the first model

Applied Pressure (MPa)	Minimum Stresses (MPa)	Maximum Stresses (MPa)
10	54.22	75.337
20	108.44	150.67
30	162.66	226.01
40	216.88	301.35
50	271.1	376.69



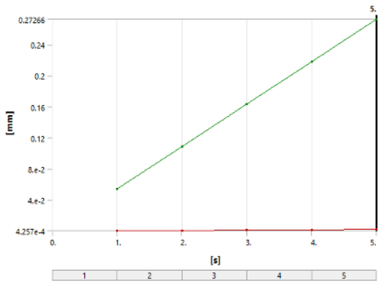
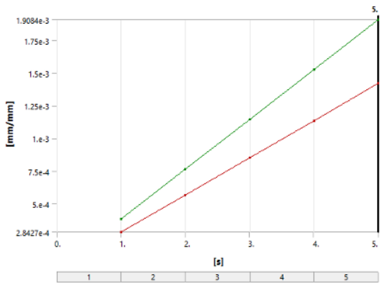


Figure 11. Equivalent elastic deformation **Figure 12.**Total displacement



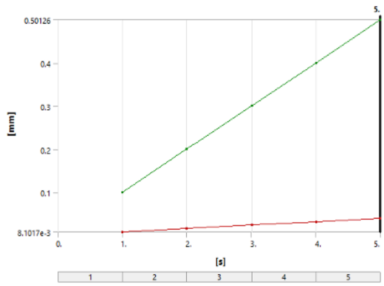


Figure 13. Equivalent elastic deformation **Figure 14.** Total displacement

4.CONCLUSION

From the previous results of tensile-strength test the first model shows that when we perform a good penetration the maximum stress point Stationed on the pipe that's mean the base metal and give 376.69 MPa, this value less than our maximum yield strength material, then this weld is accepted, without forget (Fig 13) and (Fig 14) tell that there is direct correlation relationship the first between the five applied pressure and deformation, the second between the pressures and displacement until 0.27 mm, but regarding second model with lack of penetration, thecritical zone stationed on weld joint that represent the weld bead we record in this area 394.39 MPa. When we compare, it's greater than the maximum yield strength for the three zones of API 5l X52 adding to all that increment in deformation and displacement. We conclude that we must have a good penetration in welding because its play a big deal in all geometries specially pipes. We mention the security side, for example defected weld create small's crack with time causes leakage or ruin of structure.

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