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6th EMship cycle: October 2015 – February 2017

Master Thesis

Welding technology for stainless steel AISI 316L – the problem of reducing deformations on decks in stern trawler hull.

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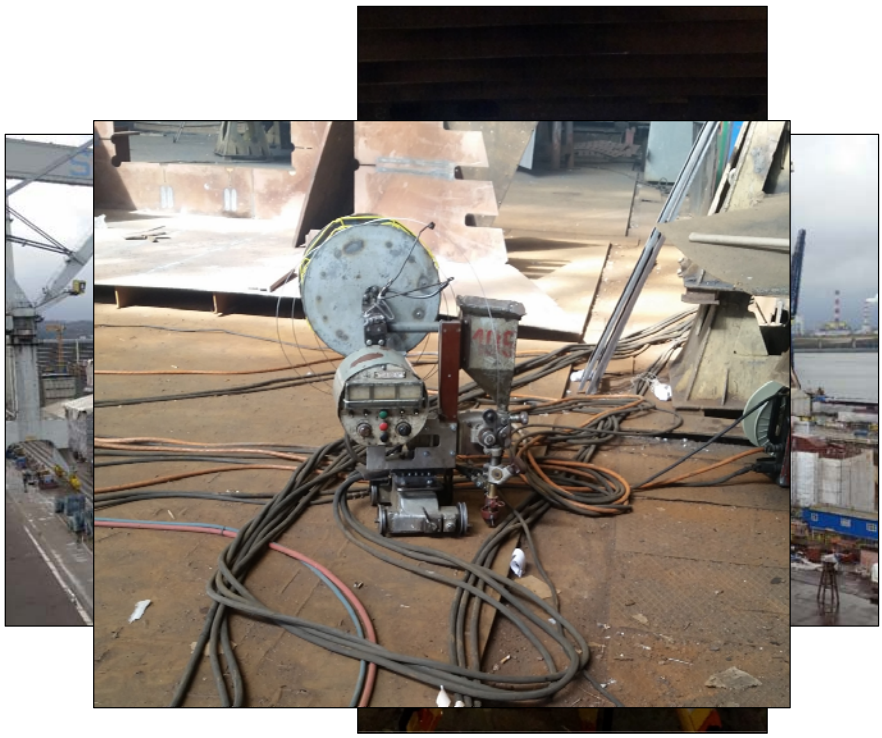
Outline

- 1 - Internship
- 2 - Introduction
- 3 - Objectives
- 4 - Methodology
- 5 - Simulation
- 6 - Results
- 7 - Conclusions

Internship

- Company: CRIST Shipyard;
- Duration: 4 months;
- Activities:
  - Production Process;
  - Measurements;
  - Welding Techonologies.



Introduction

Maritime Industry	• Maximize production; • Minimizing costs;
Joining	• Welding • FCAW and SAW
Quality	• Deformations • Increase costs

Problem Statement

- how to **reduce deformations on decks in stern trawler hull, for stainless steel AISI 316L?**

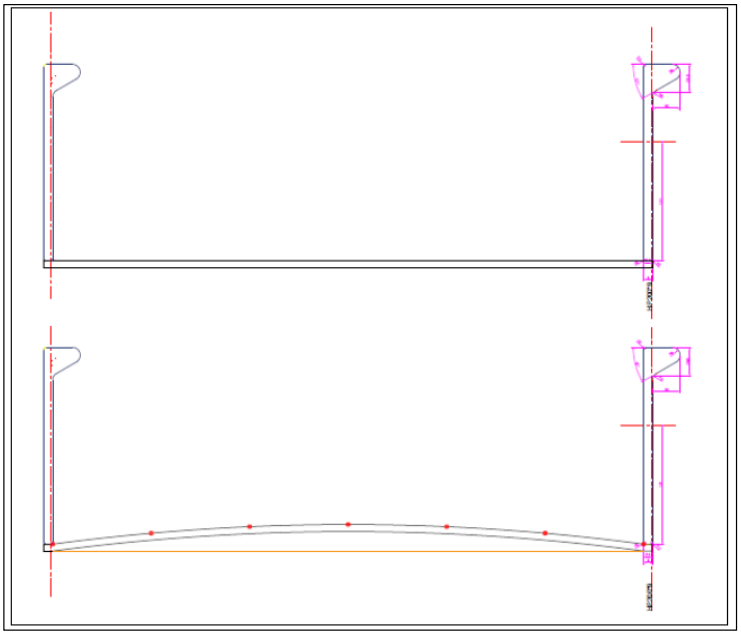
Welding technology for stainless steel AISI 316L – the problem of reducing deformations on decks in stern trawler hull.

Objectives

- Evaluate the effects of SAW and FCAW welding on decks in stern trawler hull, to reach better practices in order to reduce deformations after butt and fillet welds (stiffeners).

Methodology

- Diagnosis production process;
- Measurements:
  - Manually and,
  - Tachometer.
- ANSYS Modelling;

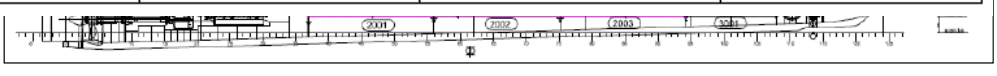


Methodology - Measurements

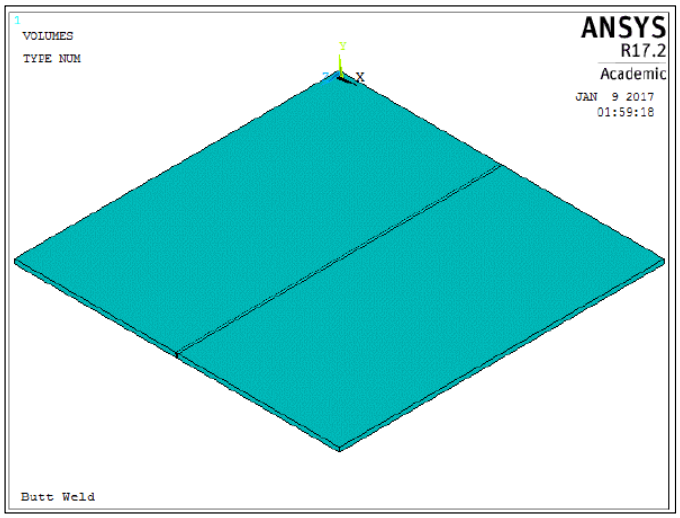
- Population: NB 395 and NB 396
  - Samples: S2004, S2005 and S2006

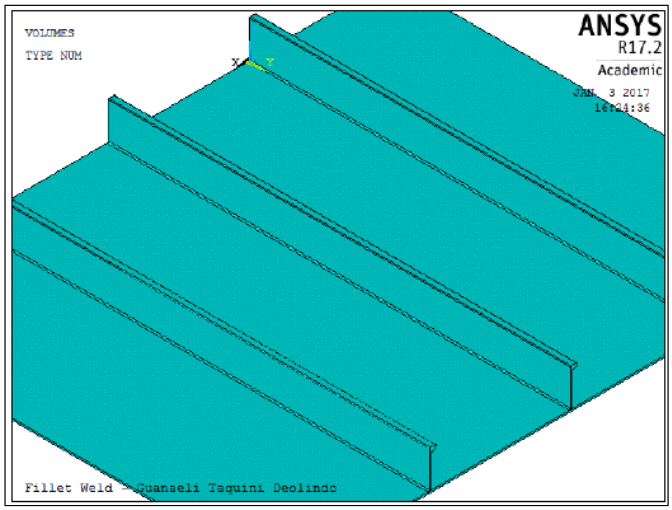
Table 6 - Measurements done during the research

Sections	Project	Thickness (mm)	Measurements		
			Before Fillet Welding	After Fillet Welding	After Straightening
S 2004	B 395	7	-	x	x
S 2005	B 396	8	x	-	-
S 2006	B 395	8	x	x	x

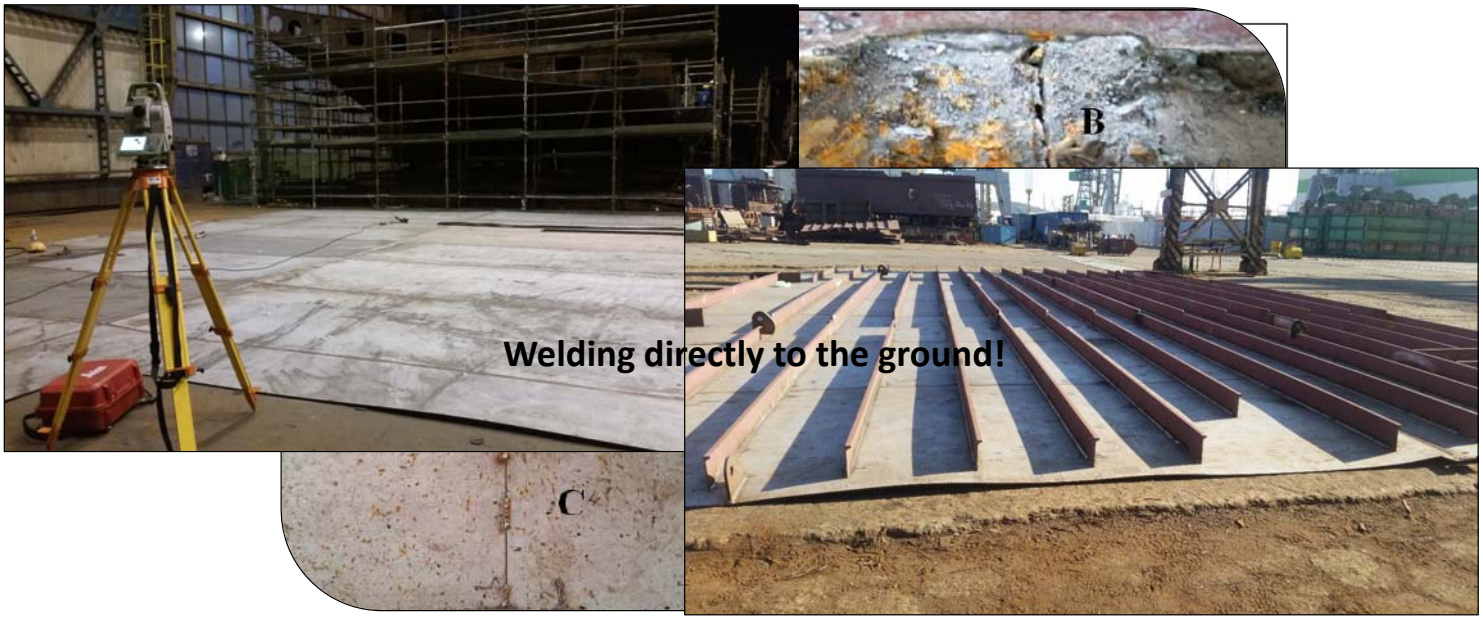


Methodology - ANSYS

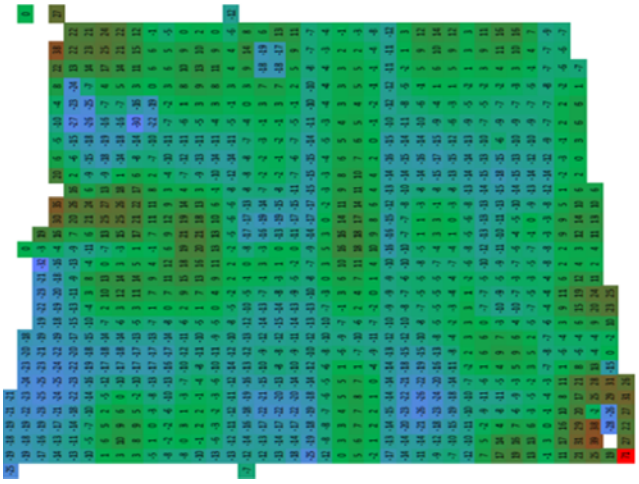


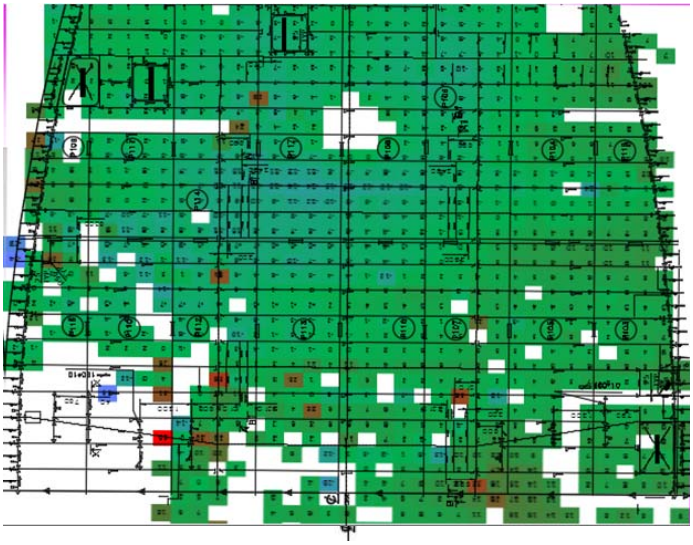


Results



Results

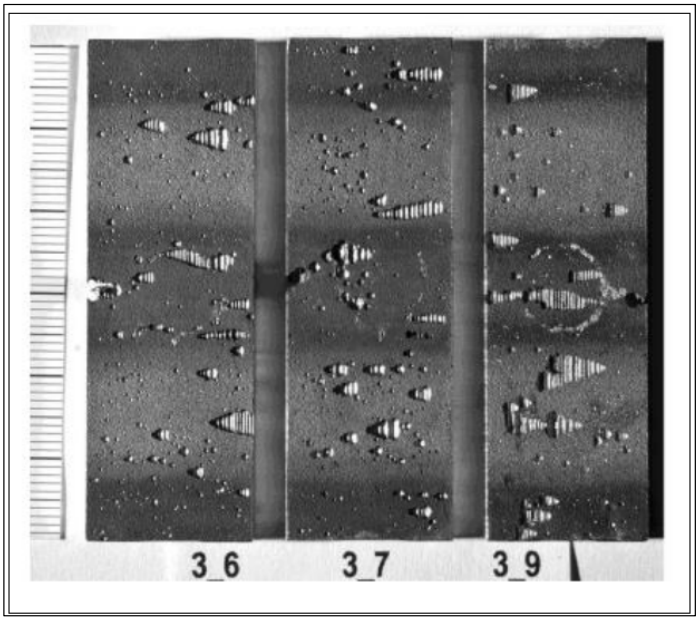




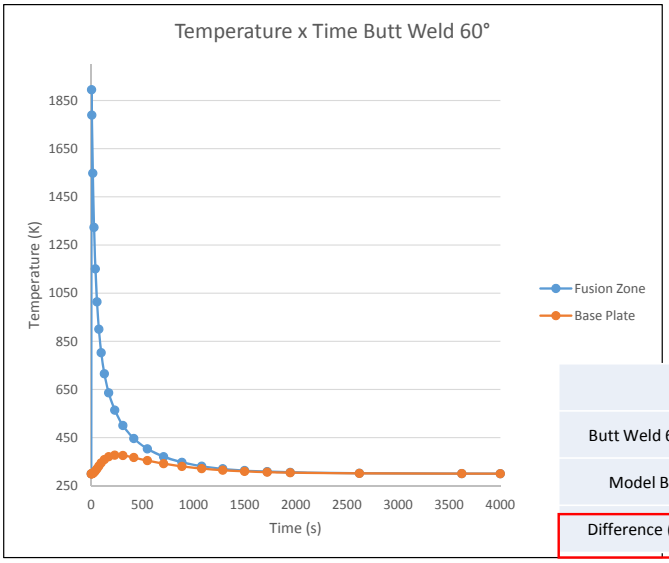
Results

	Butt Weld (mm)	Fillet Weld (mm)	Straightening (mm)
NB 395 S2004	N/A	21,98	-7,00
NB 396 S2005	10,42	N/A	N/A
NB 395 S2006	-3,64	-0,16	1,16

High deformations and corrosion presence!



Results

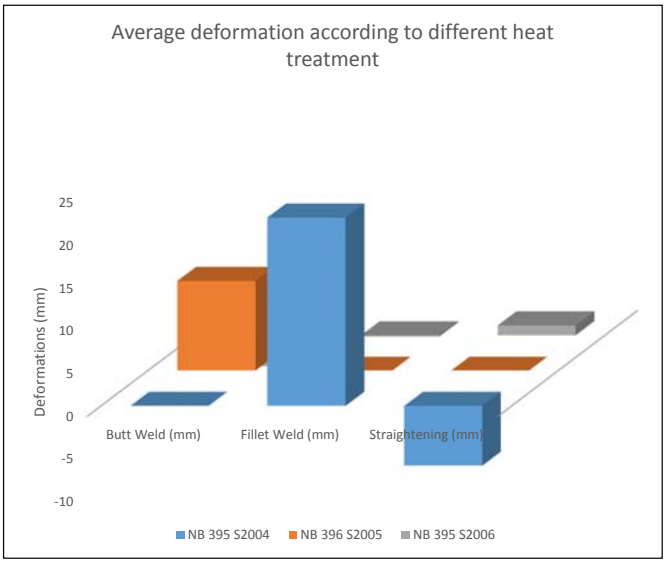


- Three Models
  - Groove angle 60°;
  - Model A: Gap 2mm and,
  - Model B: Groove angle 40°
- Better results: Model B

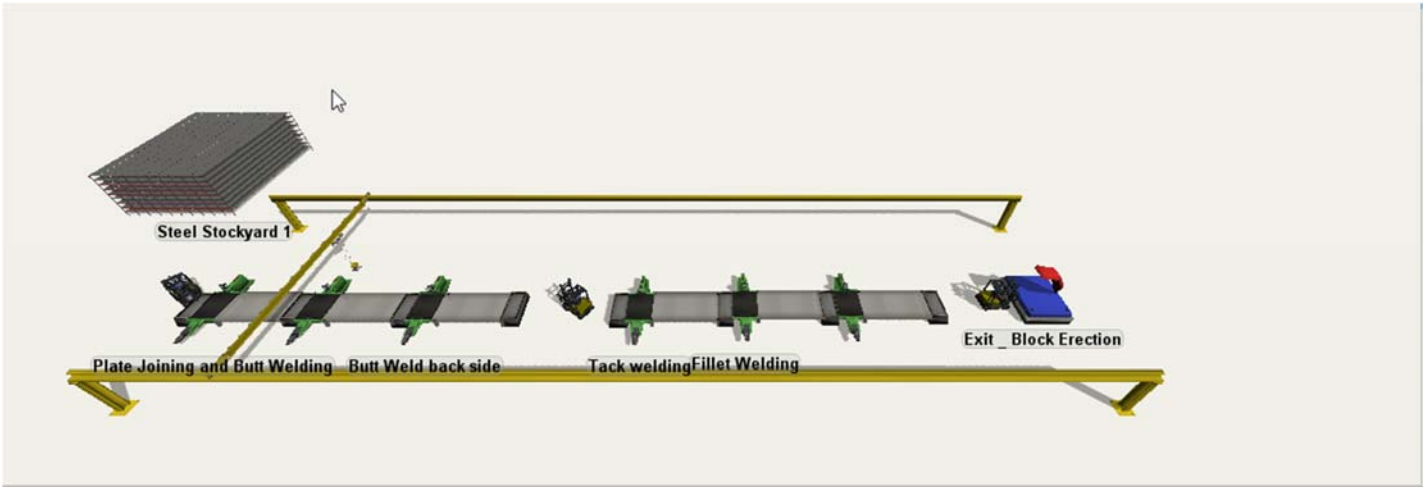
	Displacement (m)	Stress Intensity (Pa)	Von Mises Stress (Pa)	Maximum Temperature (K)
Butt Weld 60°	1,74E-06	1765200,00	1765200,00	1894,90
Model B	1,71E-06	1741300,00	1741300,00	1887,90
Difference (%)	-1,396%	-1,373%	-1,373%	-0,371%

Conclusions

- Parameters influence:
  - Weld Material;
  - Temperature;
  - Gap.
- Wrong handling of the steel;
- No following of WPS.



Conclusions – Assembly line



Future Research

- Moving heat source;
- Not constant welding speed;
- Radiation effects on the welding procedure;
- Mesh outside of the ANSYS platform;
- Accurate modeling of the weld pool;
- Filler material different from the base material (especially for the fillet welds case);
- Heat flux implemented according to the recent studies as made from Rosenthal and Goldak.

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Thanks!