Correction of welding techniques of professional welders using a virtual simulator

Good practice example

DRINVET

DIGITAL REALITY - THE BASIS OF SKILLS TRAINING

Project No. 2020-1-HR01-KA226-VET-094650

Problem description

Company: KONČAR Steel Structures Inc, Zagreb
Year: 2012/2013 - two locations

Problem:
Porosity of welded joints in production above common limits. A detailed analysis of all possible causes of porosity led to the conclusion that the cause is inadequate coverage of the welded joint with shielding gas and the cause is the welding technique.

Solution to the problem: Correction of the welder welding technique with the Fronius virtual simulator.

Input data

Name	Description
Welding process	MAG - 135
Number of welders	20 + 16 = 36
Base metal	Structural steel: S 235 J2G3, thickness 2 – 20 mm
Welding wire	Welding wire EZ – SGMo2, ø 1,2 mm
Shielding gas	Feroline C18 (82% Ar, 18% CO_2)
Welded joint	Filett weld (FW) – 80%, sl, ml, 1 – 3 passes Butt weld (BW) – 20%, ss nb, ml, 2 – 3 passes
Welding positions	FW – PB, PF BW – PA, PF

Training concept - Tailor made

Name	Description
Virtual simulator	Fronius
Welding process	MAG - 135
Welded joints	Filett weld: sl, ml; 1 – 3 passes; Butt weld: ss nb, ml; 2 – 3 passes
Welding positions	Fillet weld: PB, PF; Butt weld: PA, PF
Material, electrode, shielding gas, sheet thickness	Same as in the previous table
WPS	According to the data from the previous lines
Initial test	Simulation defined according to WPS
Training	The parameters are set by the trainer, and the training is led by "Ghost" (simulator)
Final testing	Simulation defined according to WPS

Co-funded by the
Erasmus+ Programme
of the European Union

Virtual Welding Training System Fronius, Austria

Technology: VR Virtual Reality

Welding process: MMA, MAG, TIG, robotic welding (MAG)

Material: low alloy steel

Workpiece / welded joint: plate, fillet weld, butt weld, pipe to pipe, pipe to plate

Welding positions: PA, PB, PD, PE, PF, PG, PH, PJ,

Welding technique: push – pull

Other possibilities:

- Welding training system

- Training analysis

- Reproduction of training (playback)

Co-funded by the
Erasmus+ Programme
of the European Union

Virtual Welding Training System Fronius

Video: **Training sequence** and Simulation sequence
Weldng process: **MAG 135**

Training sequence:
A virtual teacher ("Ghost") gives the Best help possible

Simulation sequence:
Training in a "real" welding situation (with no help from the Ghost)

Initial test -simulation

Actual welding situation.

According to WPS, the trainer sets the welding parameters and determines the difficulty of the exam.

After getting acquainted with the device, the welder makes a welded seam.

The welder who pulled the correct weld, goes immediately to the final test (simulation)

The initial test involves making only one weld according to WPS.
The weight of the test was determined to be 75%.
The simulator tests three sizes:
...the welding speed
...the distance from the workpiece
...the tilt angle of the welding torch

For a passing grade, each of the three tested sizes must score at least 750 points.

Training

The virtual teacher – called "Ghost" – ensures optimum help is given when mastering...

...the welding speed
...the distance from the workpiece
...the tilt angle of the welding torch / electrode holder / addition of the filler metal

Colour signals provide immediate feedback corrections can be made instantly. The colors are the colors of the traffic lights:
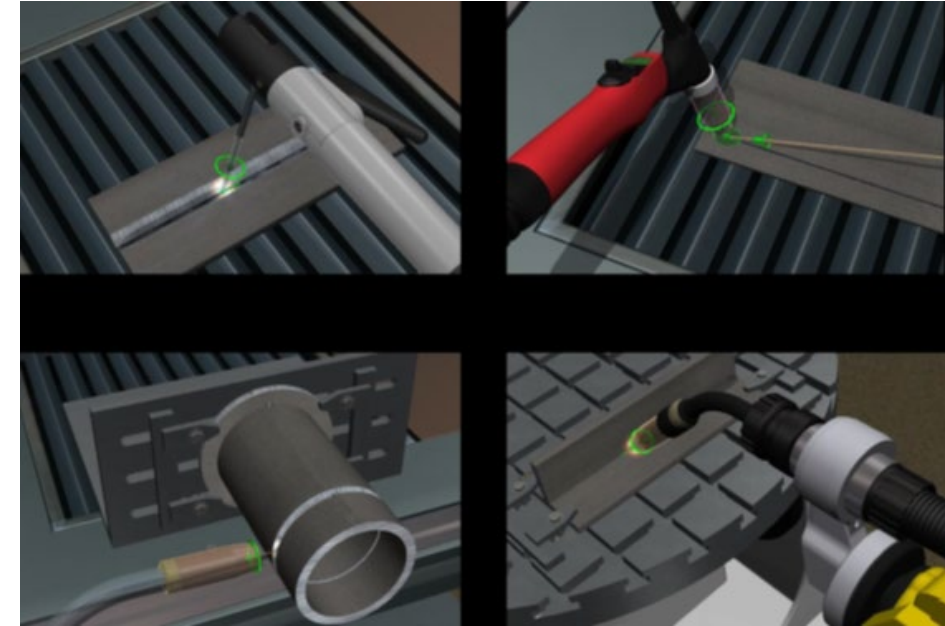…red - bad, needs significant correction
…yellow - moderate, needs a small correction
…green - excellent, no correction

Training: Tailor-made by Končar MK

For each WPS training is performed as follows:

It is done in a group. One welder trains on the simulator and the others monitor his work on the screen. The maximum number of welders in the group is 5.

It works in the Training sequence.

1. The welder on the simulator pulls the weld with the help of the virtual teacher "Ghost". The condition to complete the training is 5 consecutive well-executed welds. All three sizes are evaluated: welding speed, distance from the workpiece and torch angle.The maximum number of welds in one training is 20. After that, the training is approached by another welder from the group. Training difficulty level 65% (650 points /tested size) The training is repeated until it is successfully completed.

Final testing - simulation

For each WPS training is performed as follows: It is done in a group. One welder trains on the simulator and the others monitor his work on the screen. The maximum number of welders in the group is 5.It is done in Simulation sequence.

1. The welder on the simulator pulls the weld without the help of the virtual teacher "Ghost". The condition to complete the training is 3 consecutive well-executed welds. All three sizes are evaluated: welding speed, distance from the workpiece and torch angle. The maximum number of welds in one training is 10. After that, the training is approached by another welder from the group.
2. A welder who does not have three consecutive good welds in 10 withdrawn welds, returns to training.
Training difficulty level 65%.

Training results

Evaluation	Initial Test		Training						Final Test			
	Only one attempt		The first training		Second training				The first attempt		Second attempt	
No. welders						36						
	🟢 good	🔴 bad	🟢 good	🔴 bad	🟢 good	🔴 bad			🟢 good	🔴 bad	🟢 good	🔴 bad
EN 287-1 135 P BW 1.2 S t10 PA ml, 3 passes	12	24	18	6 + 4	10	0			30	6	6	0
EN 287-1 135 P BW 1.2 S t10 PF ml, 2 passes	6	30	18	12 + 2	14	0			27	9	9	0
EN 287-1 135 P FW 1.2 S t10 PB sl	20	16	9	7 + 8	15	0			32	4	4	0
EN 287-1 135 P FW 1.2 S t10 PB ml, 3 passes	15	21	11	10 + 5	15	0			29	7	7	0
EN 287-1 135 P FW 1.2 S t10 PF ml, 2 passes	4	32	18	14 + 0	14	0			26	10	10	0

DRinVET | Correction of welding techniques of professional welders using a virtual simulator

According to our knowledge, the correction of the welding technique of professional welders using a virtual simulator in this way was performed for the first time in the world!!

The average improvement of the technique of one welder after two days of training is given in the following table:

	Improvement [%]
EN 287-1 135 P BW 1.2 S t10 PA ml, 3 passes	10,9
EN 287-1 135 P BW 1.2 S t10 PF ml, 2 passes	37,1
EN 287-1 135 P FW 1.2 S t10 PB sl	3,5
EN 287-1 135 P FW 1.2 S t10 PB ml, 3 passes	11,6
EN 287-1 135 P FW 1.2 S t10 PF ml, 2 passes	28,7

Porosity monitoring12 months after training revealed the following:

1. Individual significant porosity errors began to occur after 6 months of training.

2. In the next 5 months, the level of errors reached the maximum allowable limit according to the company's standards.

3. The conclusion is that in order to achieve optimal results in the reduction of defects in welded joints, the welding technique of the welder should be corrected at least once a year.

Author:

Željko Habek

zeljkohabek@gmail.com

#STRUKA

www.struka.hr

info@struka.hr