Travel Angle Effect on GMAW Welding of A36

LeTourneau University
MATERIALS JOINING ENGINEERING

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Problem Statement

Travel angle can be a debated topic on its importance and the effect of travel angle on penetration. The purpose of this research was to revisit historic views on travel angle and test the theories with modern machines and robotics.

Background

- A36 is a common steel used in many industries and is frequently GMAW welded in fillet joints.
- A drag travel angle is a travel angle where the wire is pointed back into the weld pool or opposite of the direction of travel
- Push travel angle is a travel angle where the wire is pointed away from the weld pool and deposited weld or in the direction of travel
- Travel angle effects weld profiles and penetration. A drag angle is generally associated with increased penetration, while a push angle is generally associated with decreased penetration.

Objective

- Determine the effect on penetration from travel angle on fillet welds.
- Compare throat and penetration of drag and push angles.

Methods

Materials

- 1/4” A36 base metal with ER70S-6, 0.035”, filler wire.

Welding

- Yaskawa Welding Robot with a Miller power supply
- Best parameters were chosen based on weld bead size and geometry from test at 0-degree travel angles and 45-degree work angle. Table 1 list weld parameters.

Sample Preparation

- T joints were all cleaned of mill scale and rust before welding and tack welded prior.
- The samples were loaded into a jig in the robot cell.

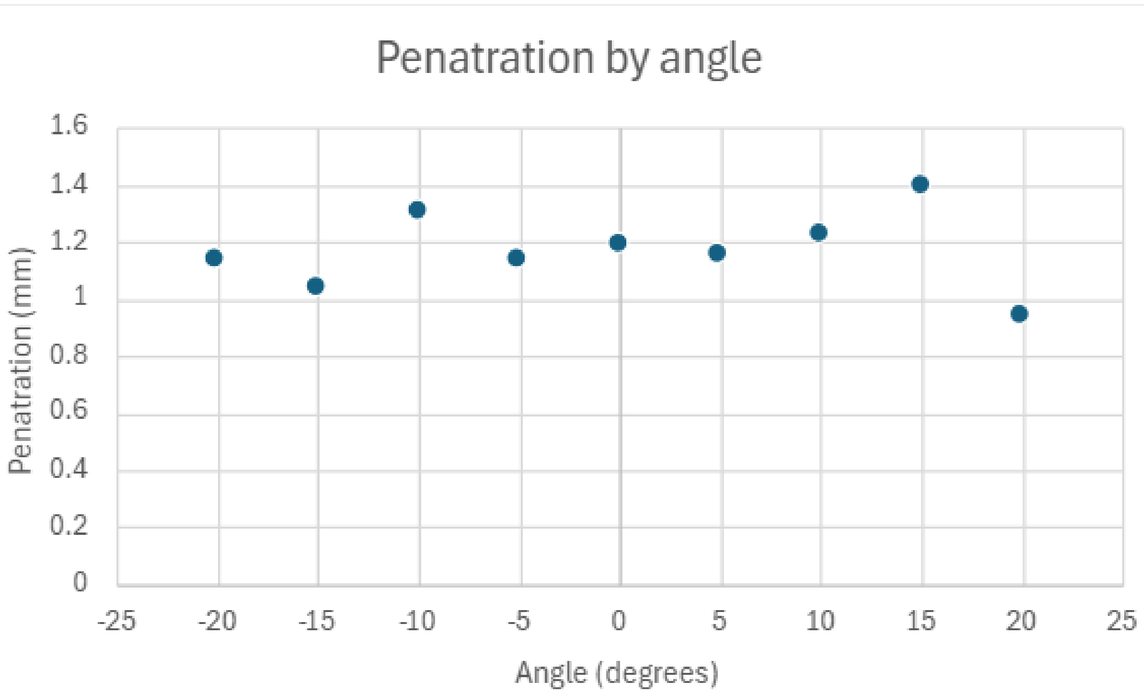
Material Testing

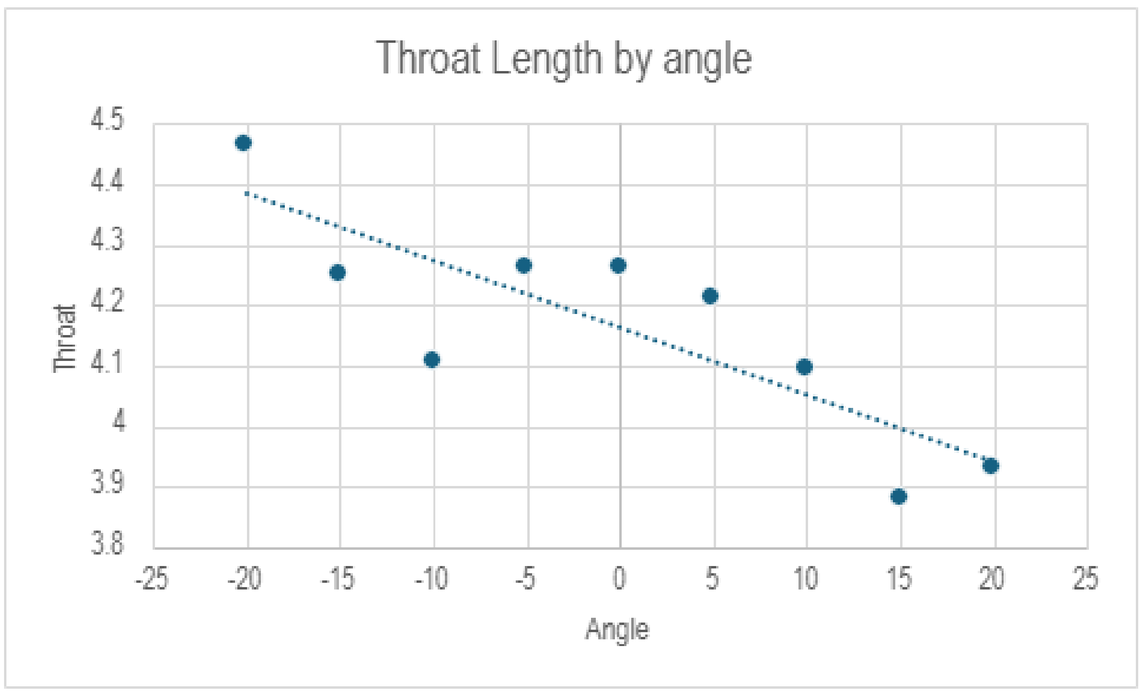
- All samples were cut and etched using 2% Nital.
- All weld size properties were measured with a calibrated macroscope.

WFS	300 IPM
Voltage	20 V
Travel Speed	14 IPM

Table 1

Results





- Negative angles indicate a “drag” angle, Positive angles indicate a “push” angle.
- Each point represents the average of 2 samples.

Discussion

- The data shows that penetration remains relatively constant from -10 to 10 degrees. Once that point is passed the drag angles stayed around the same while the 20 degree push angle dropped drastically in penetration. The changes in penetration are only slight. There are limitations in the scope of the experiment, including material thickness, wire size, weld parameters, and sample size. It is possible that with different parameters travel angle has more effect.
- The throat size followed the expected trend. As the angle went more to a drag the throat size increases. As the travel angle goes into a push angle the throat size decreases and the bead flattened. There was variation in throat size of the parts likely due to slight work angle variations. The trend is clear despite the sample at -10 degrees.

Conclusions

- Penetration showed little change from the travel angle sample size tested
- Throat size increases the more drag angle is applied
- Throat size decreases as more push angle is applied

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