

Introduction to Welding Case Studies

Introduction to Welding – Case Studies

Purpose: Provide a concise, easy-to-read overview of how real-world welding projects illustrate key concepts, techniques, and decision-making processes.

1. Why Use Case Studies in Welding Education?

Benefit	Explanation
Contextual learning	Shows how theory (heat input, metallurgy, joint design) translates into actual fabrication.
Problem-solving focus	Highlights challenges (distortion, defects, safety) and the steps taken to resolve them.
Decision-making insight	Demonstrates how welders choose processes, filler metals, and parameters based on material, geometry, and service conditions.
Industry relevance	Connects classroom topics to sectors such as shipbuilding, automotive, aerospace, and construction.

2. Core Elements of a Welding Case Study

1. Project Overview

- *Industry & application* (e.g., offshore platform, high-speed train).
- *Primary objectives* (strength, corrosion resistance, weight reduction).

2. Materials & Joint Design

- Base-metal grades, thicknesses, and coating conditions.
- Joint type (butt, fillet, lap, socket) and preparation (bevel angle, root gap).

3. Welding Process Selection

- Reasoning behind choosing SMAW, GMAW, GTAW, FCAW, SAW, etc.
- Considerations: productivity, accessibility, heat input, cleanliness.

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4. Parameter Settings

- Voltage, current, travel speed, shielding gas composition, filler metal size.
- Calculated heat input (kJ/mm) and its impact on microstructure.

5. Quality Assurance & Testing

- NDT methods used (UT, RT, PT, MT, X-ray).
- Acceptance criteria (ASME, AWS, ISO standards).

6. Challenges & Mitigation Strategies

- Common issues (porosity, cracking, distortion).
- Countermeasures (pre-heat, interpass temperature control, joint design modification).

7. Results & Lessons Learned

- Performance outcomes (strength, fatigue life, corrosion data).
- Recommendations for future projects.

3. Representative Case Studies

3.1. Offshore Oil Platform Girth Welds (SAW)

Item	Details
Objective	Produce high-strength, low-distortion girth welds on 25mm API 5L X80 steel plates.
Process	Submerged Arc Welding (SAW) with flux-cored wire, 2-pass weld.
Parameters	Voltage: 30V, Current: 450A, Travel speed: 8mm/s, Heat input $\approx$ 1.6kJ/mm.
Pre-heat	150°C; Interpass $\approx$ 200°C.
Inspection	Radiographic testing (RT) and ultrasonic testing (UT).
Challenge	Hydrogen-induced cracking due to high residual stresses.
Mitigation	Controlled pre-heat, low-hydrogen flux, post-weld heat treatment (PWHT) at 620°C for 2h.

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Item

Details

Outcome 100% welds passed RT; measured tensile strength 620 MPa (design requirement).

Key Takeaway: For thick, high-strength steels, SAW combined with proper thermal management minimizes cracking and yields consistent penetration.

3.2.