

MECHANICAL TESTING OF WELDS: TENSILE TESTING, HARDNESS TESTING, AND BEND TESTING

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1. PROBLEM STATEMENT

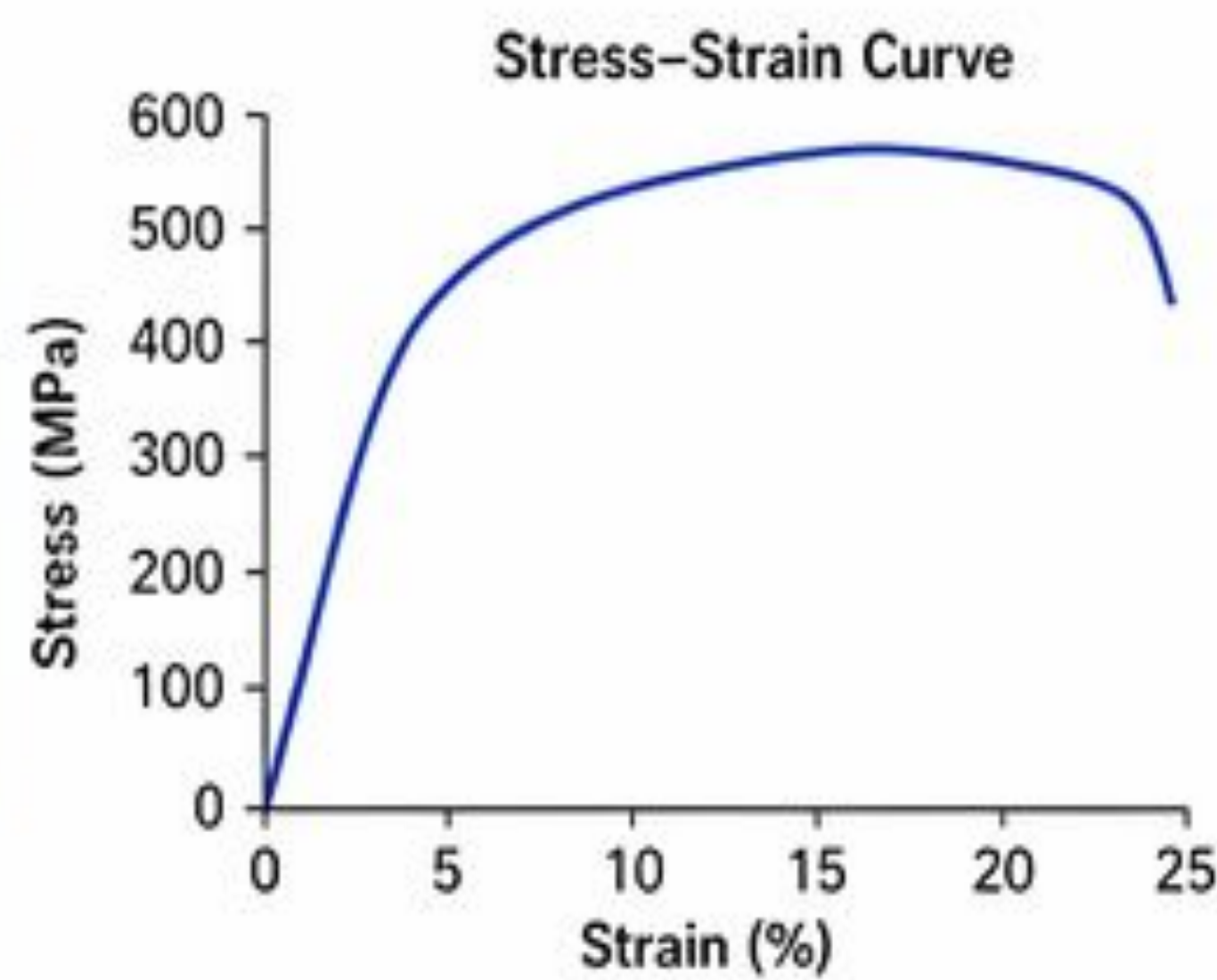
- Welding is widely used in structural applications, but welds can be the weakest region due to microstructural changes, residual stresses, and defects.

Problem:

Evaluate the mechanical performance and integrity of butt welds in mild steel using tensile, hardness, and bend testing.

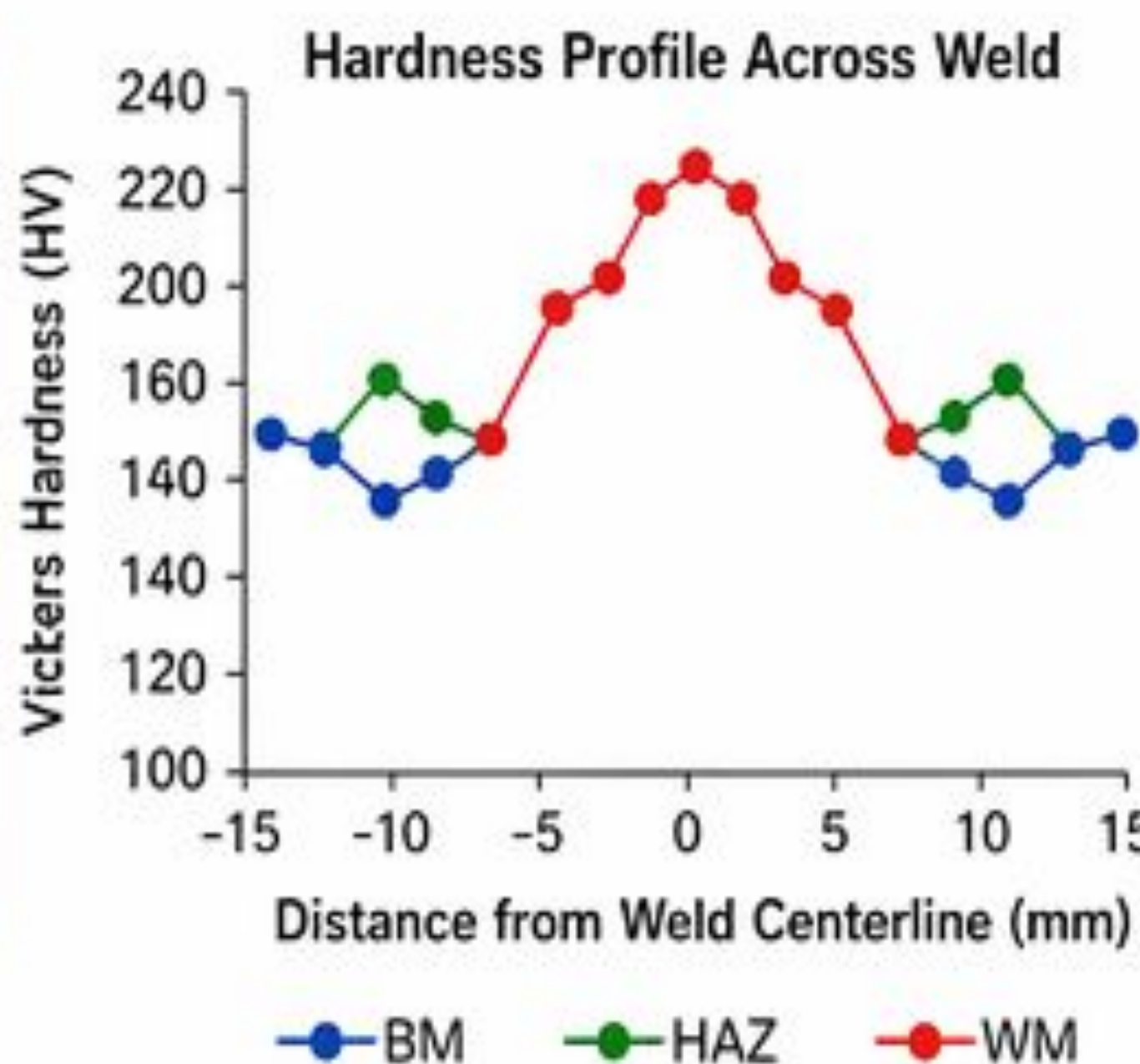
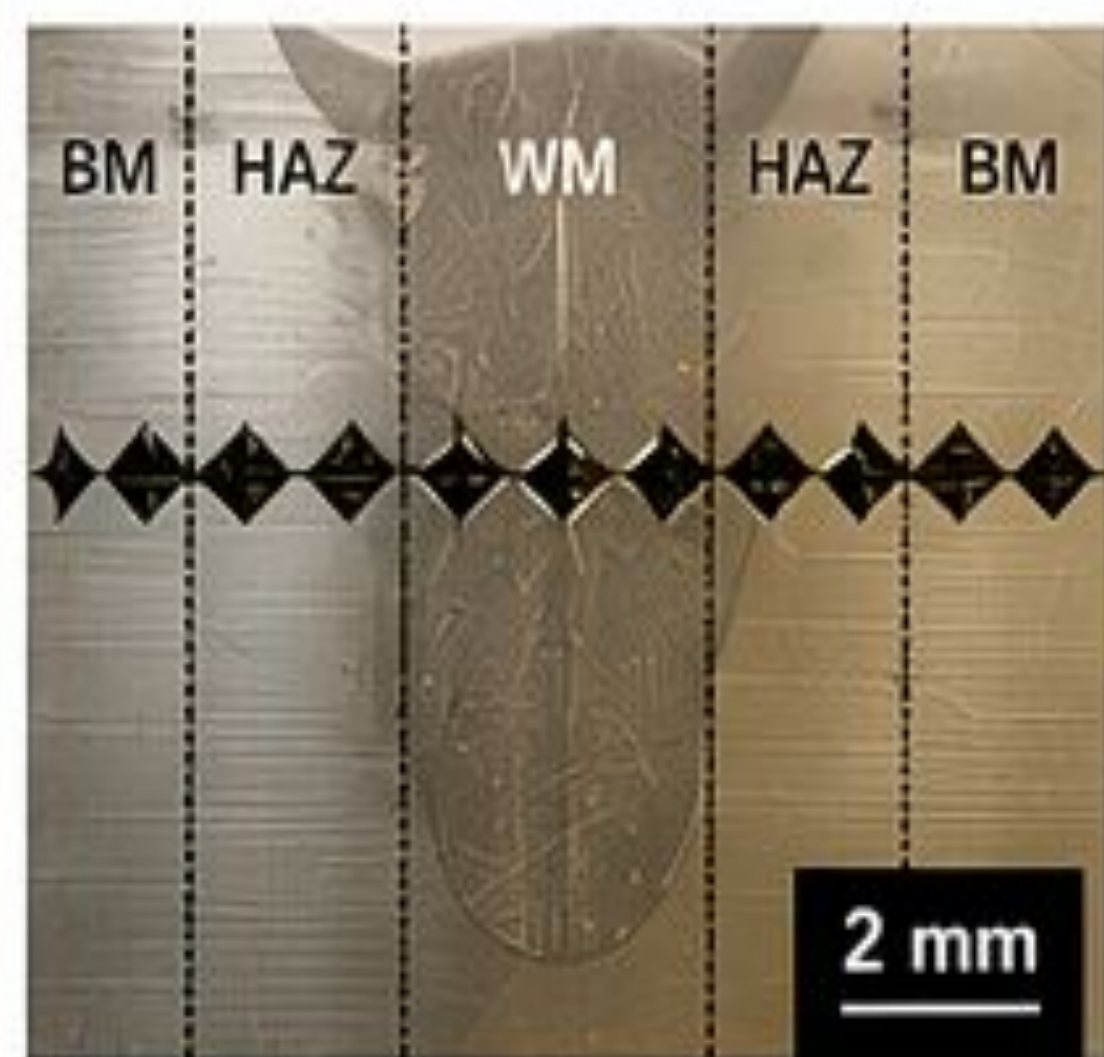
3. RESULTS

a. Tensile Testing of Welds



Specimen	Ultimate Tensile Strength (MPa)	Yield Strength (MPa)	Elongation (%)	Fracture Location
Welded Joint	522	345	21.3	Weld Metal

b. Hardness Testing



c. Bend Testing of Welds

Specimen Type	Test	Bend Angle	Observation	Result
	Face Bend	180°	No cracks or fractures on external surface	PASS
	Root Bend	180°	No cracks or fractures on external surface	PASS

All specimens passed the bend test as per acceptance criteria.

2. METHODS

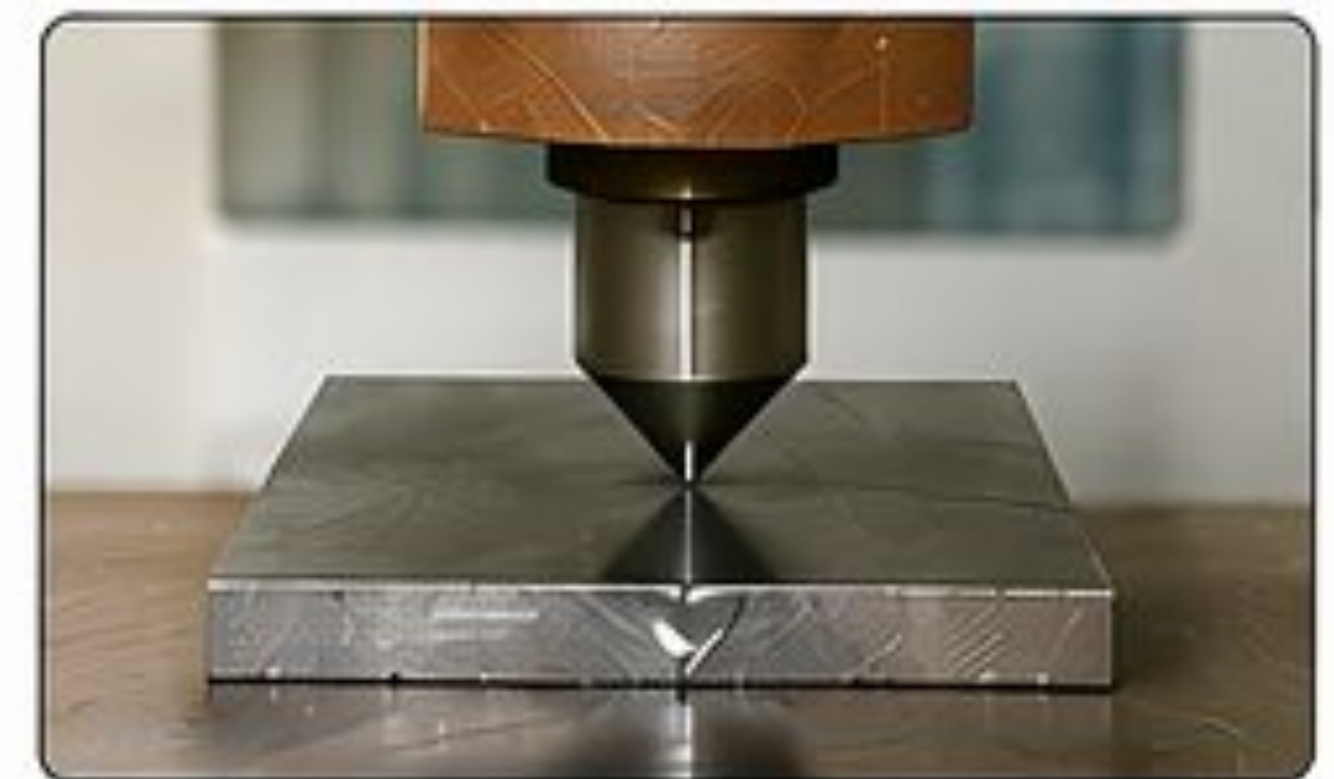
Tensile Testing

ASTM E8 standard. Dog-bone specimens were extracted transverse to the weld. Testing performed on a Universal Testing Machine (UTM) at 2 mm/min.



Hardness Testing

Vickers hardness test (ASTM E92) performed across the weld cross-section using a 10 kgf load with 15 s dwell time.



Bend Testing

Guided bend test performed as per ASTM E190. Specimens bent to 180° (face and root bend) using a three-point bending fixture.



4. DISCUSSION



Tensile Testing

- The welded joint exhibited a UTS of 522 MPa, which is ~89% of the base metal strength.
- Fracture occurred in the weld metal, indicating it is the weakest region in the joint.



Hardness Testing

- Hardness is highest in the weld metal due to finer microstructure.
- HAZ shows a slight decrease in hardness due to thermal effects.
- Base metal exhibits consistent hardness.



Bend Testing

- Both face and root bend tests passed without visible cracks.
- Indicates good ductility and sound weld quality.

Typical Weld Cross-Section (Etched)



5. CONCLUSIONS



- The welded joints demonstrated satisfactory mechanical performance in all three tests.
- The weld metal is the critical region for tensile failure, while hardness variations are within acceptable limits.
- Bend tests confirmed the ductility and soundness of the welded joints.
- Future work: Investigate the effect of welding parameters and filler materials on mechanical properties.

6. ACKNOWLEDGMENTS



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