Experimental study on the through-thickness properties of structural steel thick plate and its HAZ at low temperatures

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Research Background

☐ Background of engineering application for steel structural thick plates





Super-high rise buildings



Long-span steel bridges



large-scale steel structures

- **Crack-induced through-thickness failures and lamellar tearing failures**

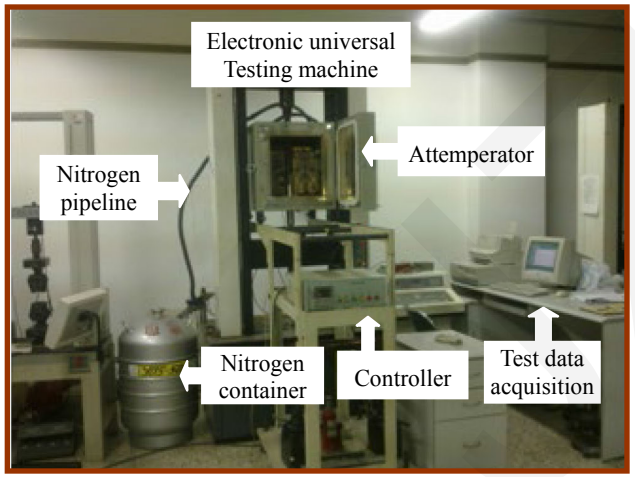
Experimental Setup

- Uniaxial tensile tests
- Charpy V-Notch impact tests
- Three-point bending (TPB) tests

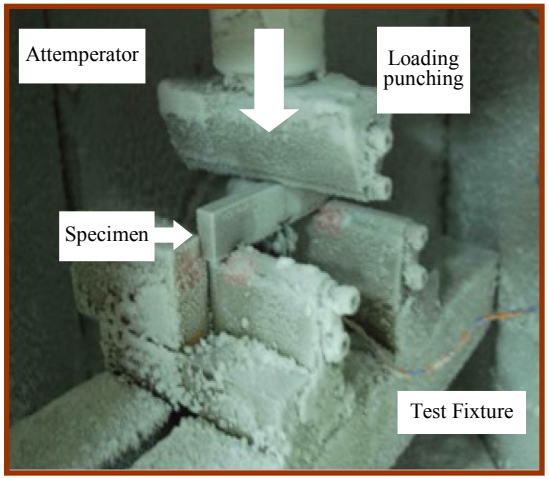
plate thickness

weld size

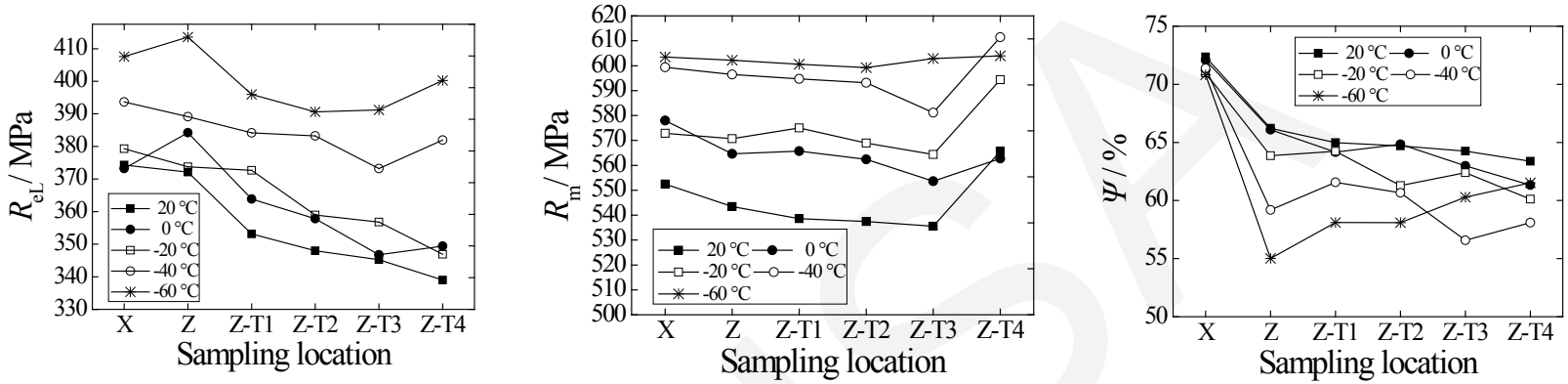
ambient temperature



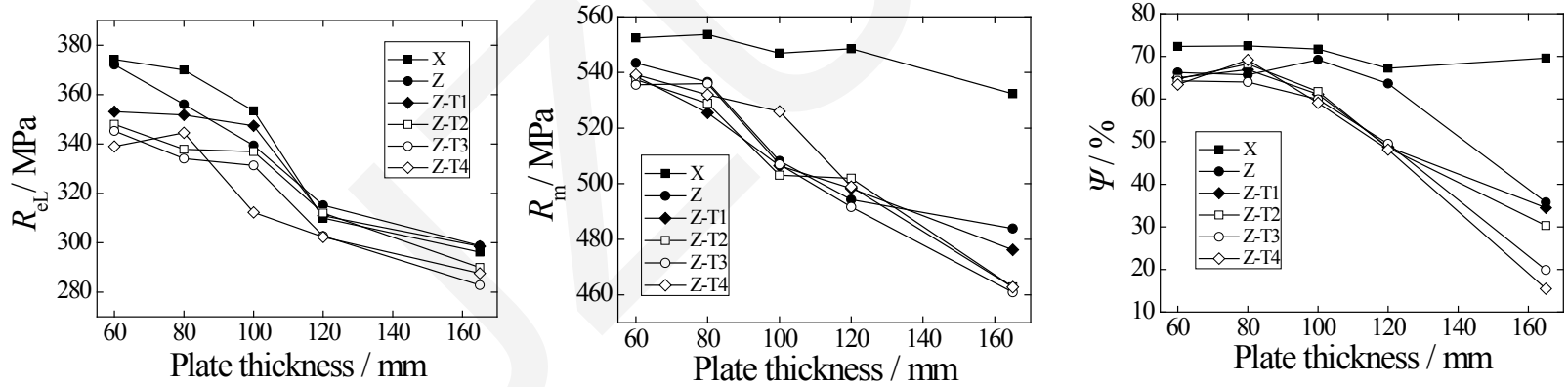




Experimental Results (Tensile)

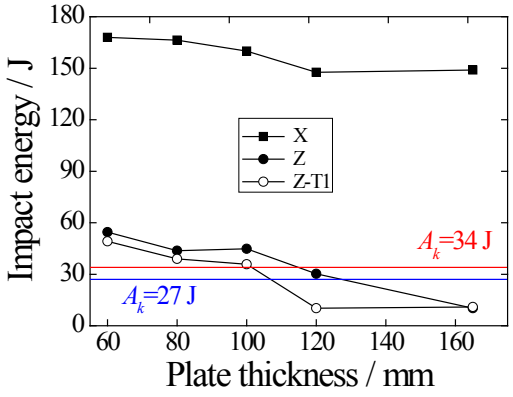


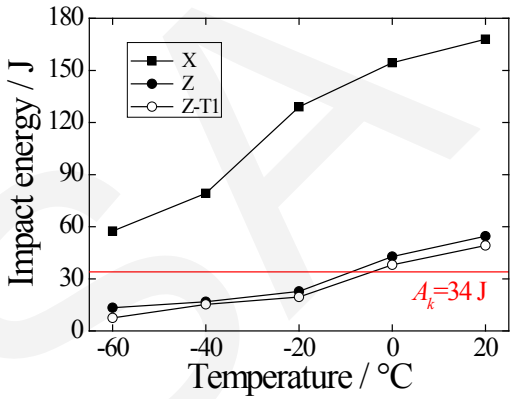
Mechanical properties versus sampling location and temperature for the 60 mm plate



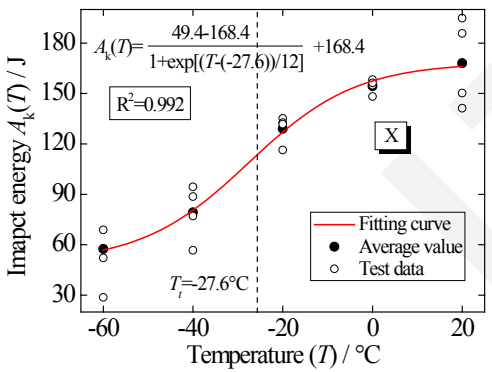
Mechanical properties versus plate thickness at temperature 20 ℃

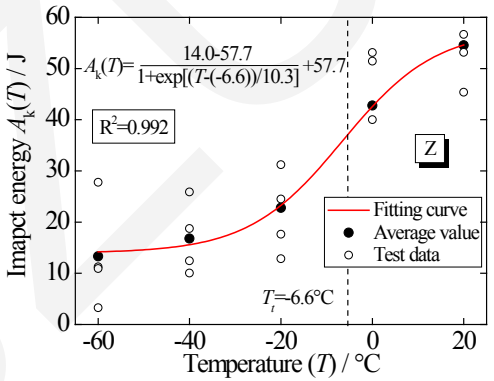
Experimental Results (Impact)

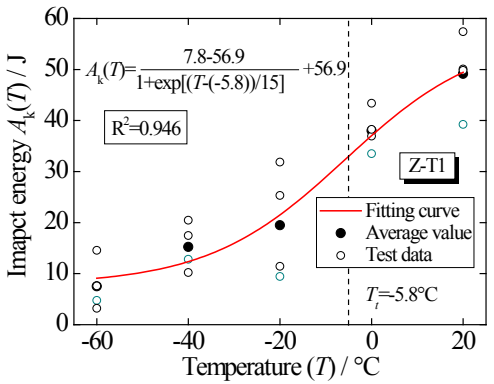




Charpy impact energy versus temperature and plate thickness

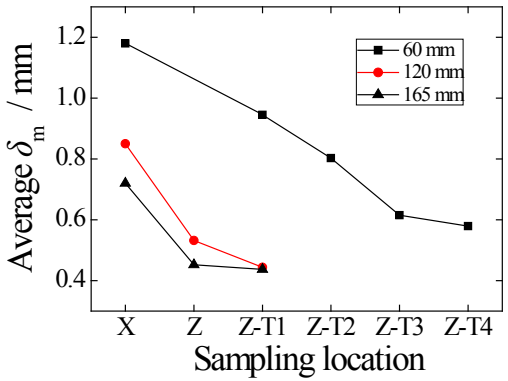


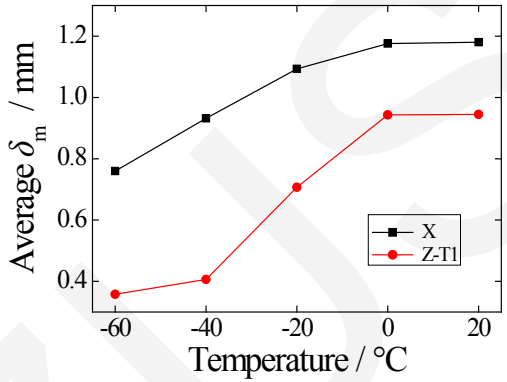


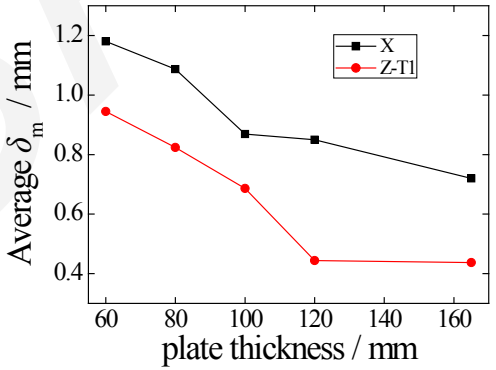


Charpy temperature transition curves for the 60 mm plate

Experimental Results (TPB)







CTOD Valuesδm versus different sampling location, temperature and plate thickness

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Conclusions

- Generally, the yield strength, ultimate tensile strength, ductility index, Charpy impact toughness and fracture toughness along the transverse direction are superior to those along the through-thickness direction.
- The adverse effect of welding heat input reduces these through-thickness mechanical and toughness indices to some extent, indicating the deteriorated through-thickness properties of HAZ.
- Also, the through-thickness properties seem to be more susceptible to variation in temperature and plate thickness than the transverse properties.

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