

Material related Issues

Fracture Control Design, #12

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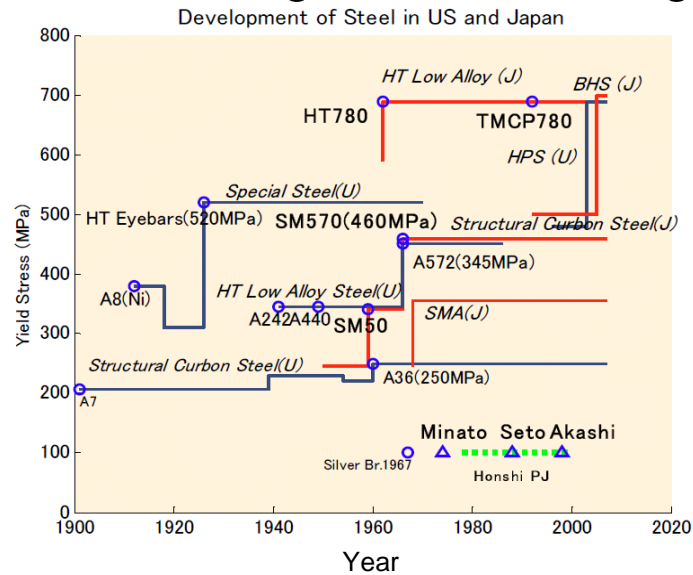
Topics:

- Historical review
- Fracture control
- Critical crack length

Historical Review of Material Properties

1979	Iron bridge UK
1826	Memai Bridge UK
1880	Eads Bridge USA, first steel bridge
1983	Brooklyn Bridge USA, steel, cable
1890	Forth bridge UK, steel

Historical change of steel strength



Chemical composition

C, C_{eq}, P_{CM}

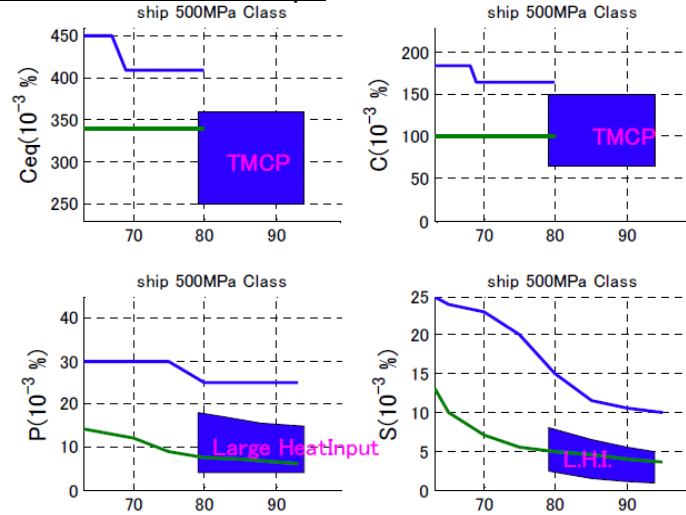
Weldability: occurrence of weld crack

$$C_{eq} = C + \frac{Si}{24} + \frac{Mn}{6} + \frac{Ni}{40} + \frac{Cr}{5} + \frac{Mo}{4} + \frac{V}{14}$$

$$P_{CM} = C + \frac{Si}{30} + \frac{Mn + Cu + Cr}{20} + \frac{Ni}{60} + \frac{Mo}{15} + \frac{V}{10} + 5B$$

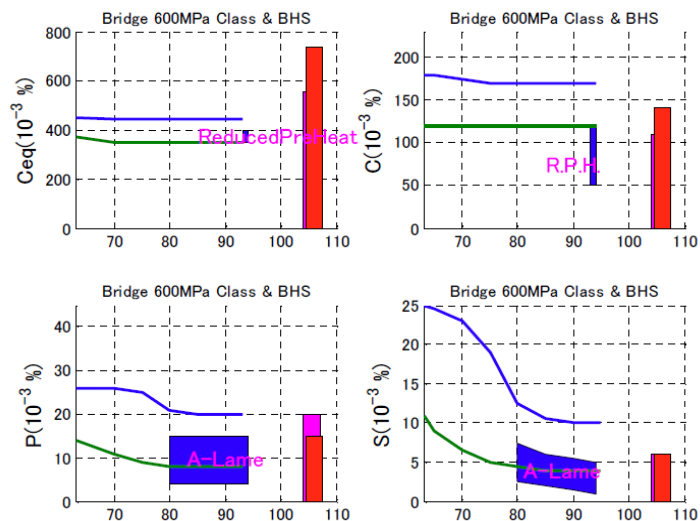
Chemical composition

500MPa class steels for ships

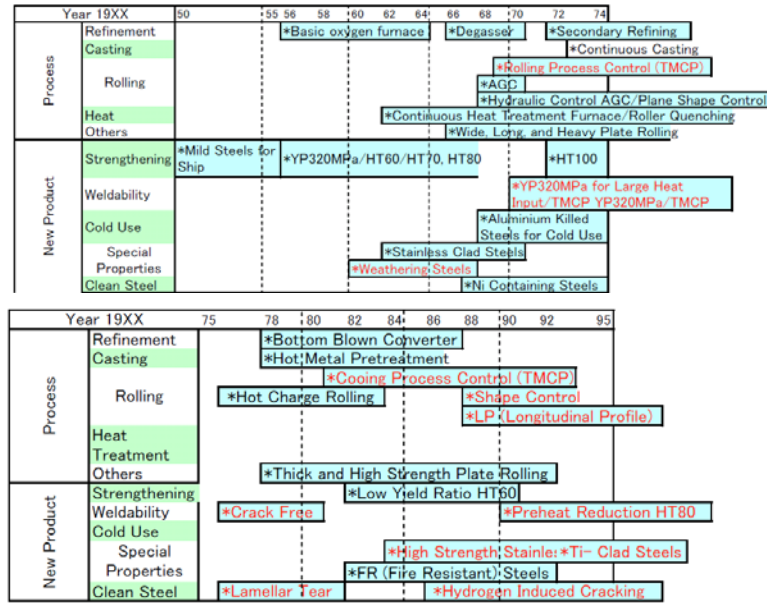


Chemical composition

600MPa class steels for bridges & BHS

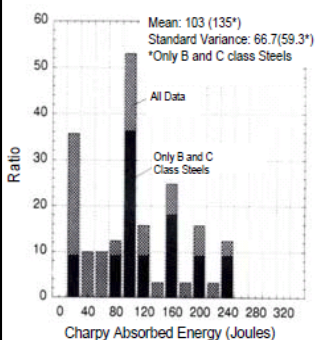


Developments of steel production

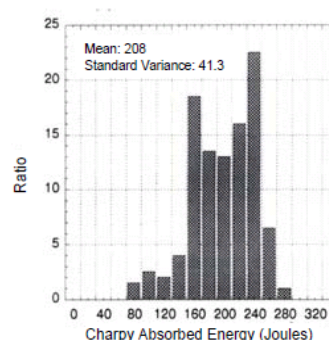


Charpy Absorbed Energy

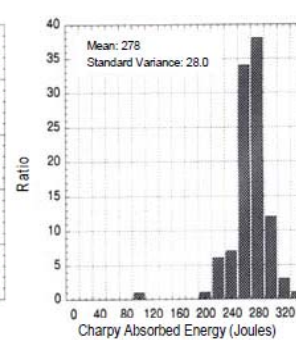
JIS structural Steel 1970s



SM490YB 1990s

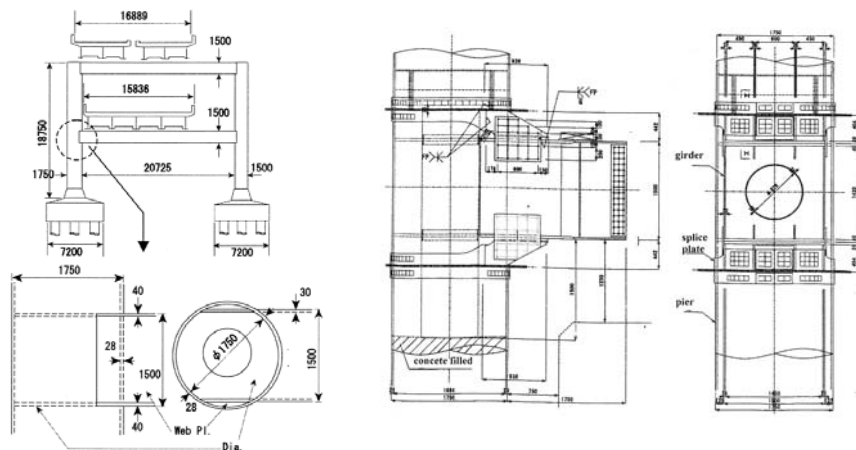


SM570Q 1990s



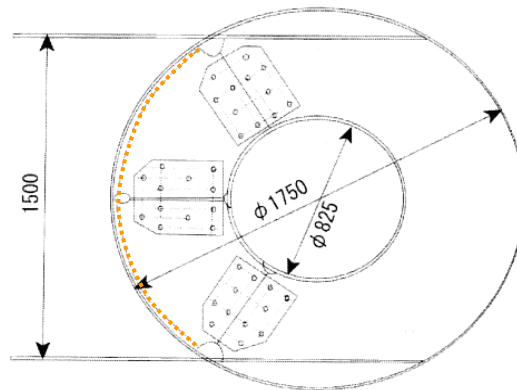
Lamellar Tearing

Old problem, but still important



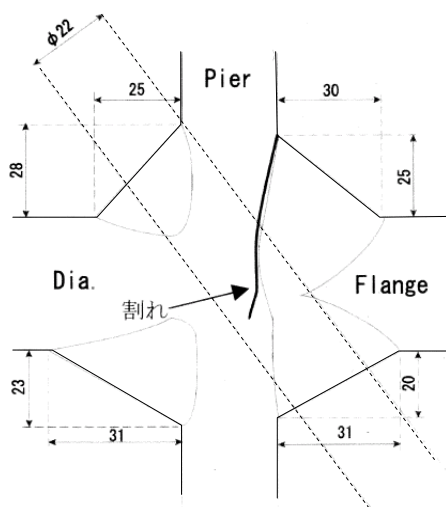
Repairing weld

Because of very low stress fluctuation

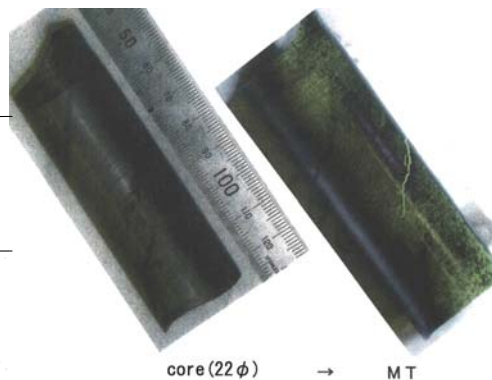


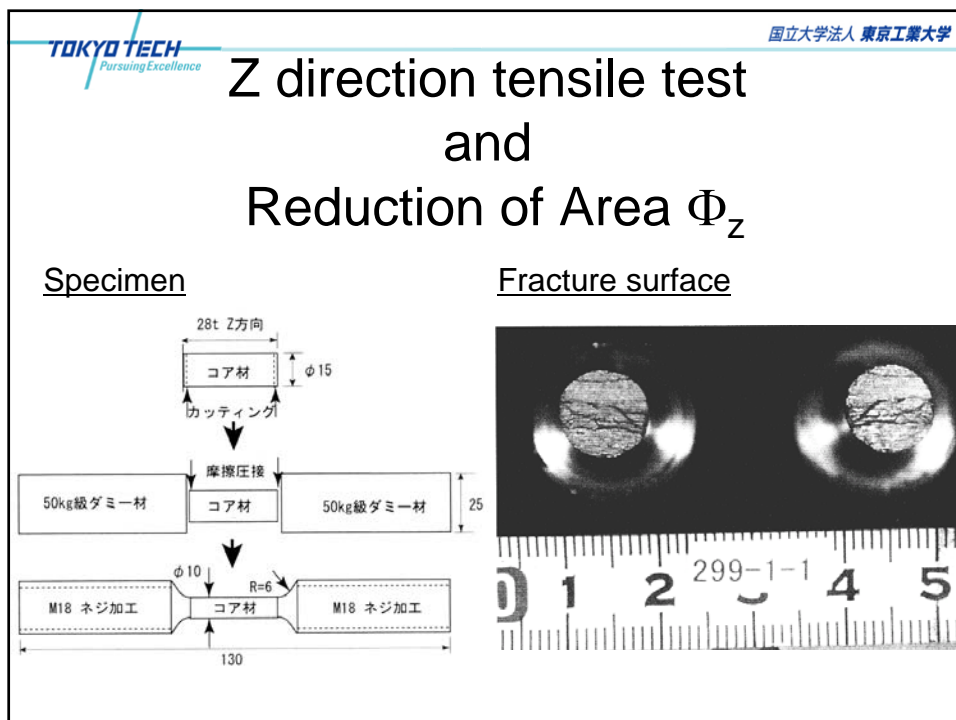
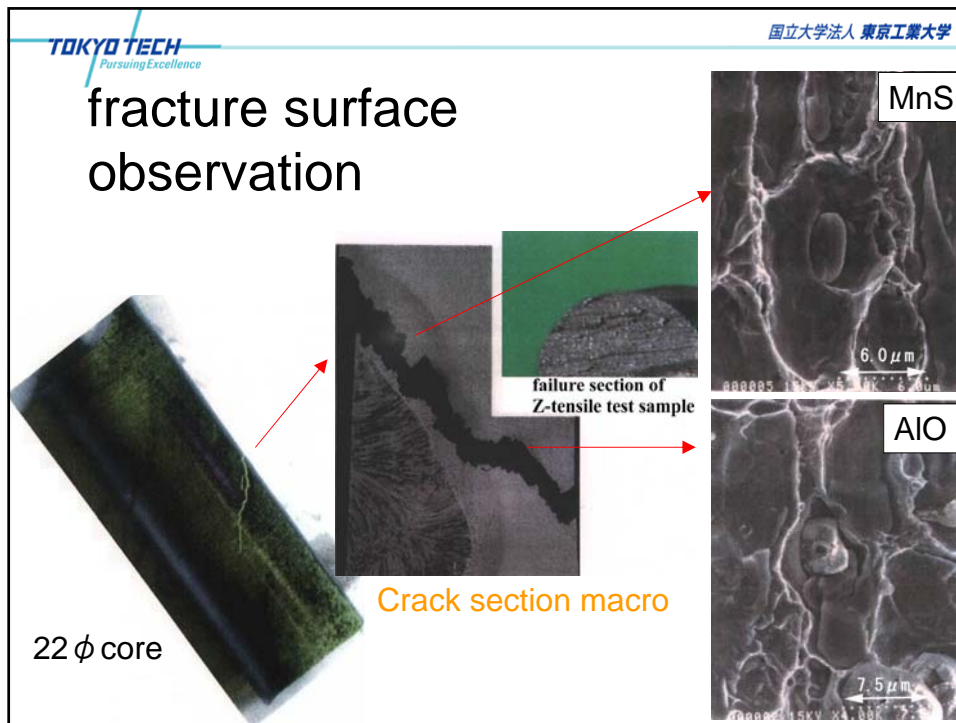
Lamellar tearing

UT results

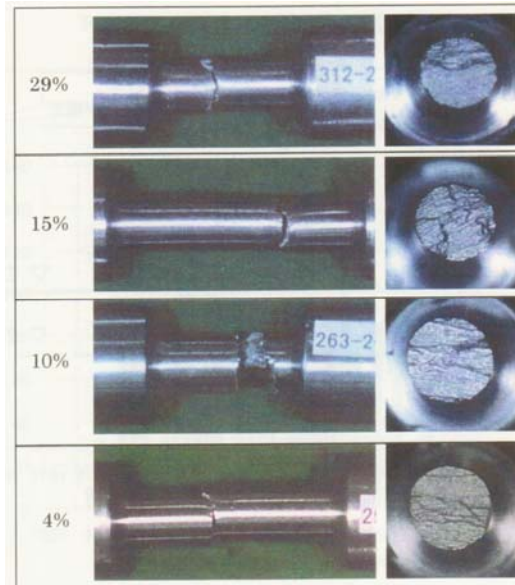


Coring

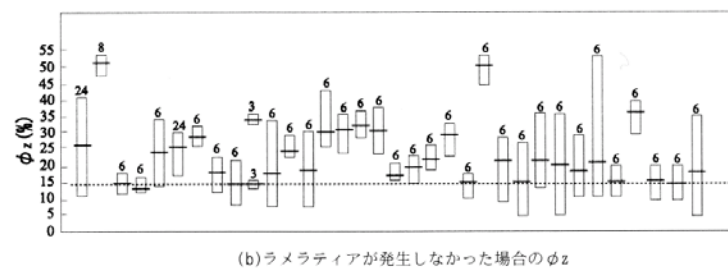
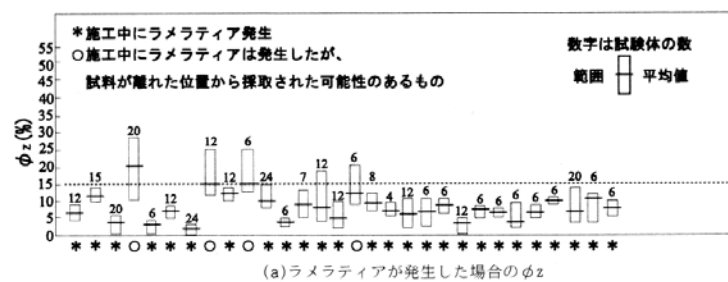




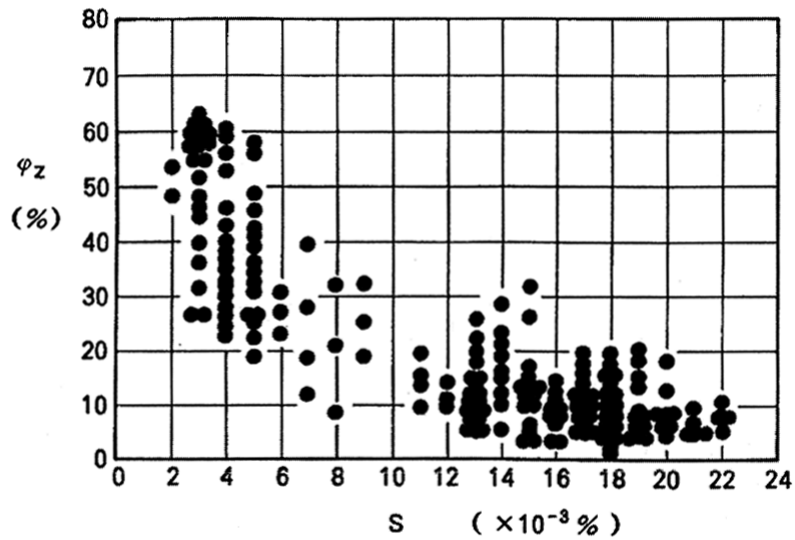
Test results



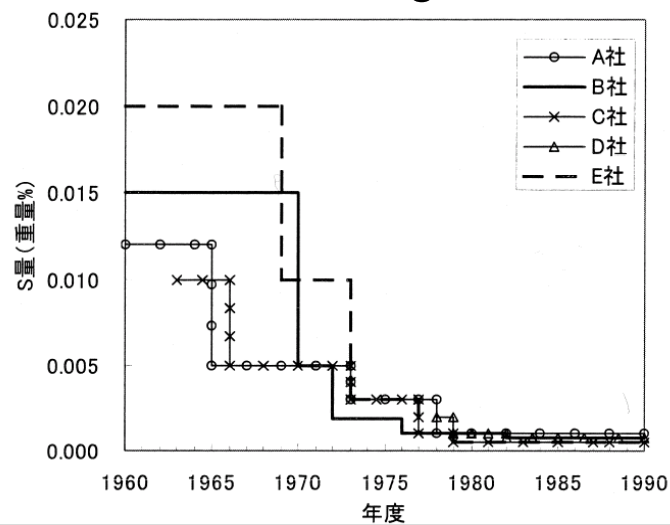
Occurrence of Lamellar Tearing and Φ_z



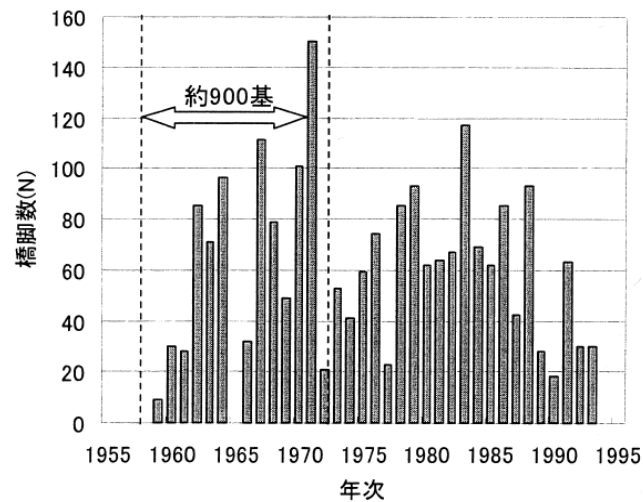
Content of Sulfur S and Φ_z



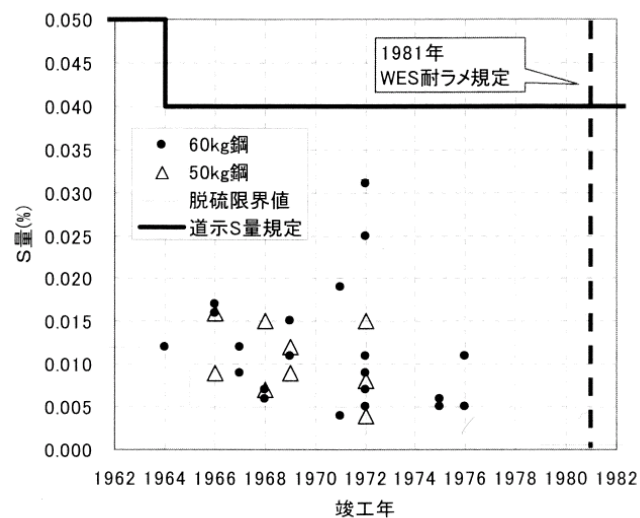
Capability of Removal of Sulfur in Steel Making Process



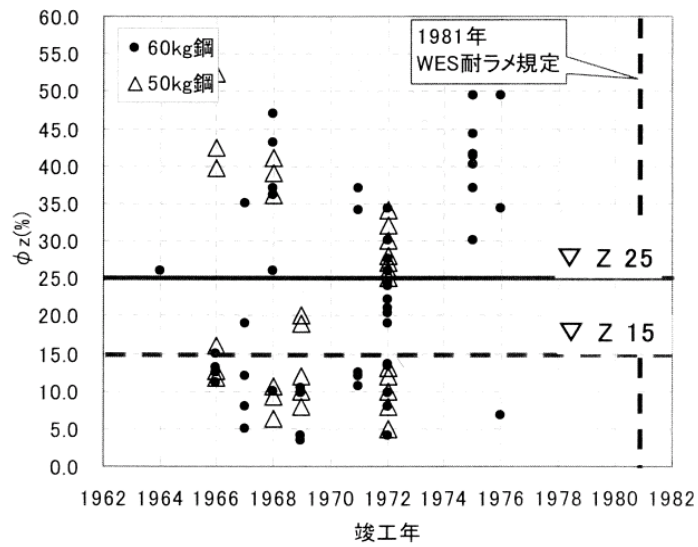
History of Steel Bent Construction in MEX



Results of z-direction tests for cores from piers Construction year and Sulfur Content



Construction year and Φ_Z



Sulfur content and Φ_Z

