

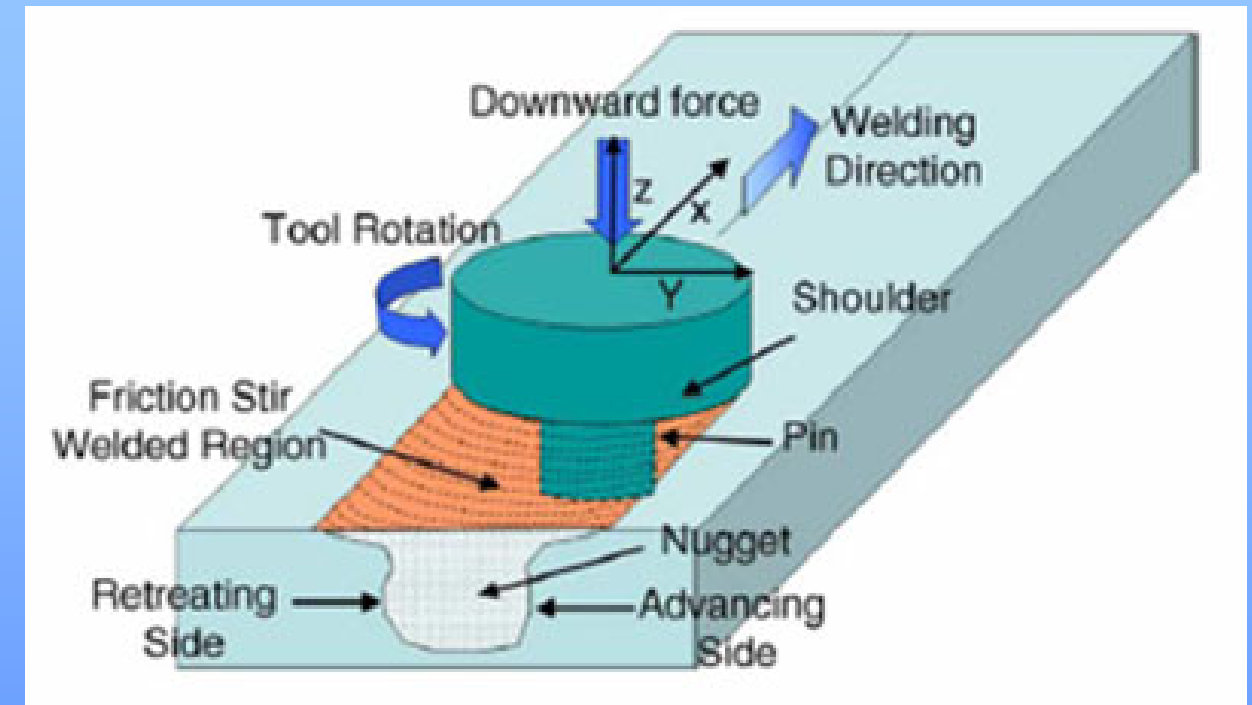
Friction Stir Welding of high strength aluminum alloys

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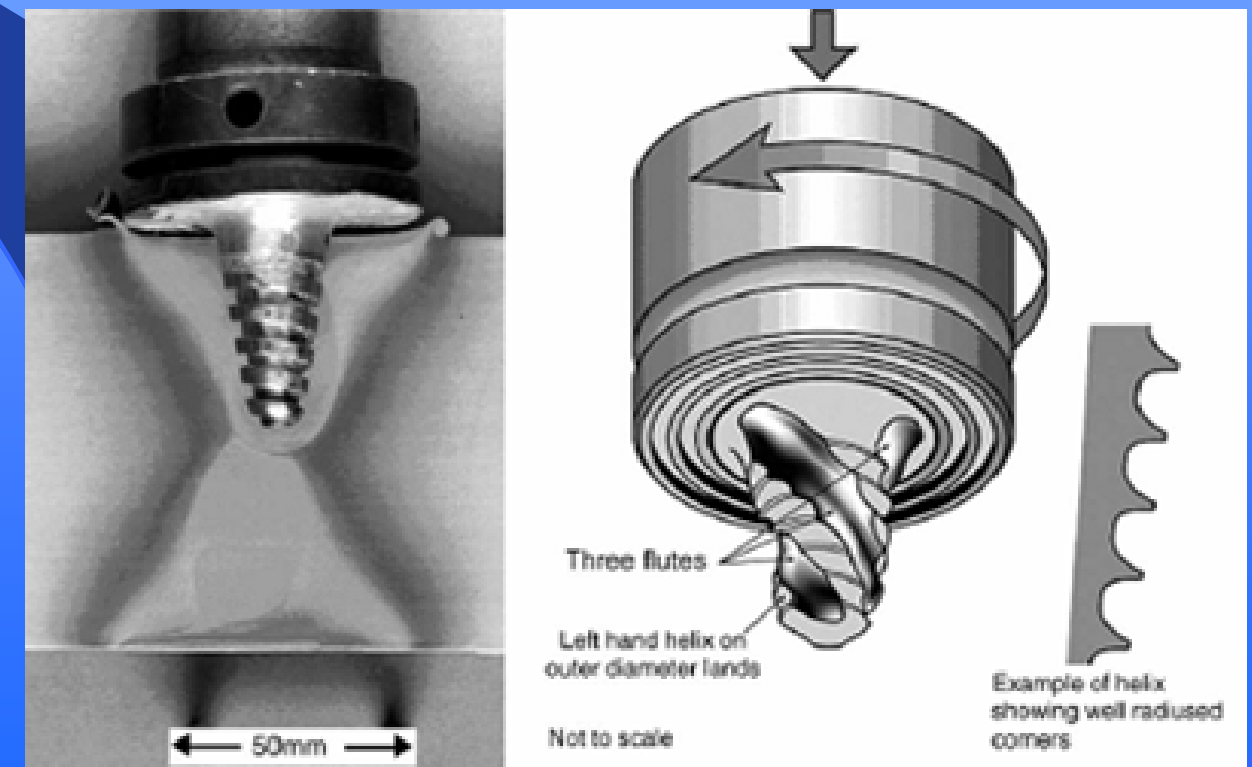
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What is FSW

- Developed 15 years ago at TWI, UK
- Solid state joining technique
- Non consumable rotating tool
- Intense plastic deformation (stirring) at elev. temp. (friction) → fine & equiaxed recrystallized grain structure
- Several benefits
 - controllable parameters
 - repeatable
 - high strength AA
 - energy efficient



FSW technique



Worl™ tool and MX-Triflute™ tool



Applications of FSW

- Aerospace (example: new **A350** family)
 - up to 50% FSW joints (fuselage & wings, tail section, structure elements)
 - Space shuttle fuel tank
 - Automotive
 - Railway and shipping
- reduced costs and improved performance

BUT ...

in the early days residual stresses were often assumed to be low despite lack of evidence



A350-800

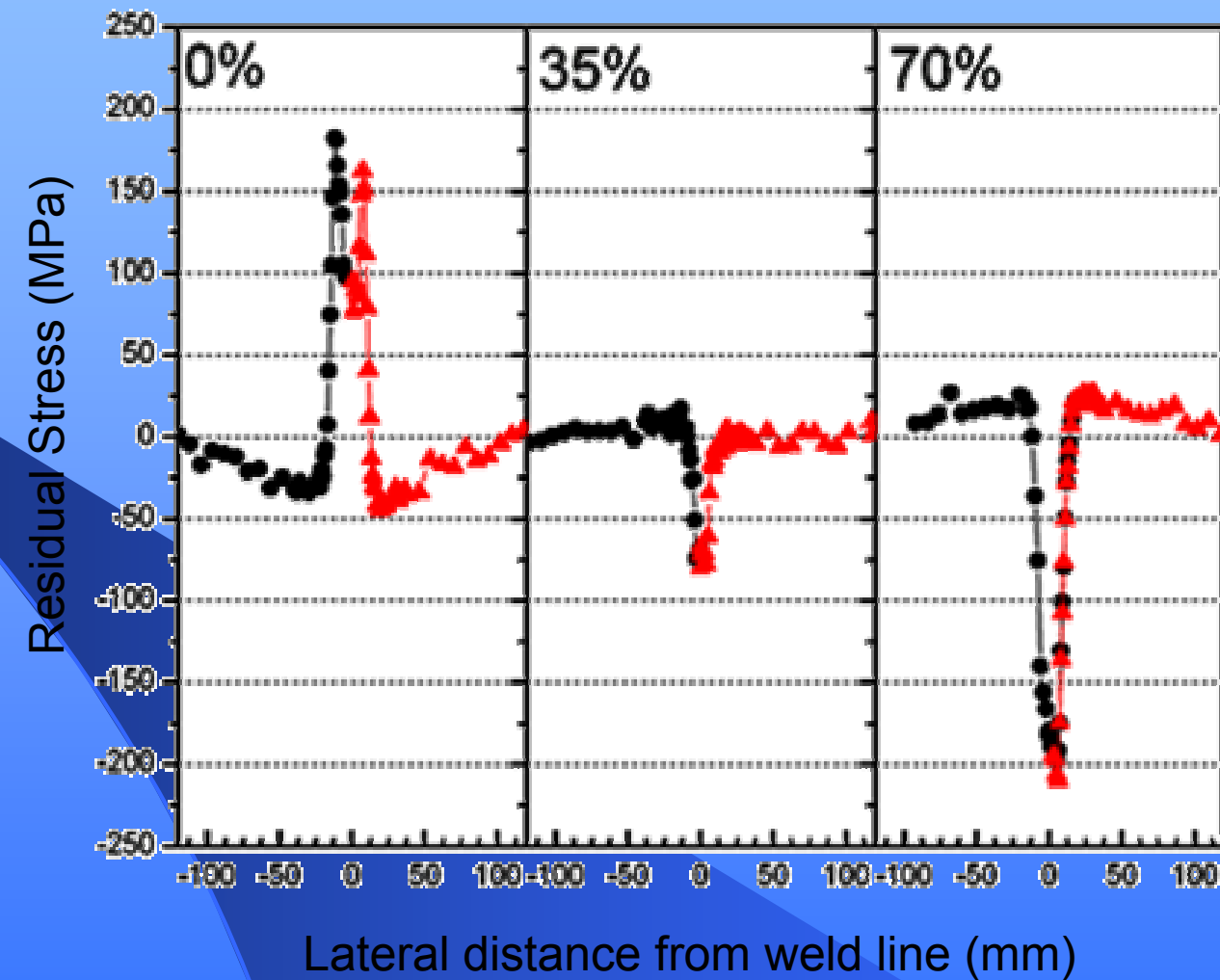
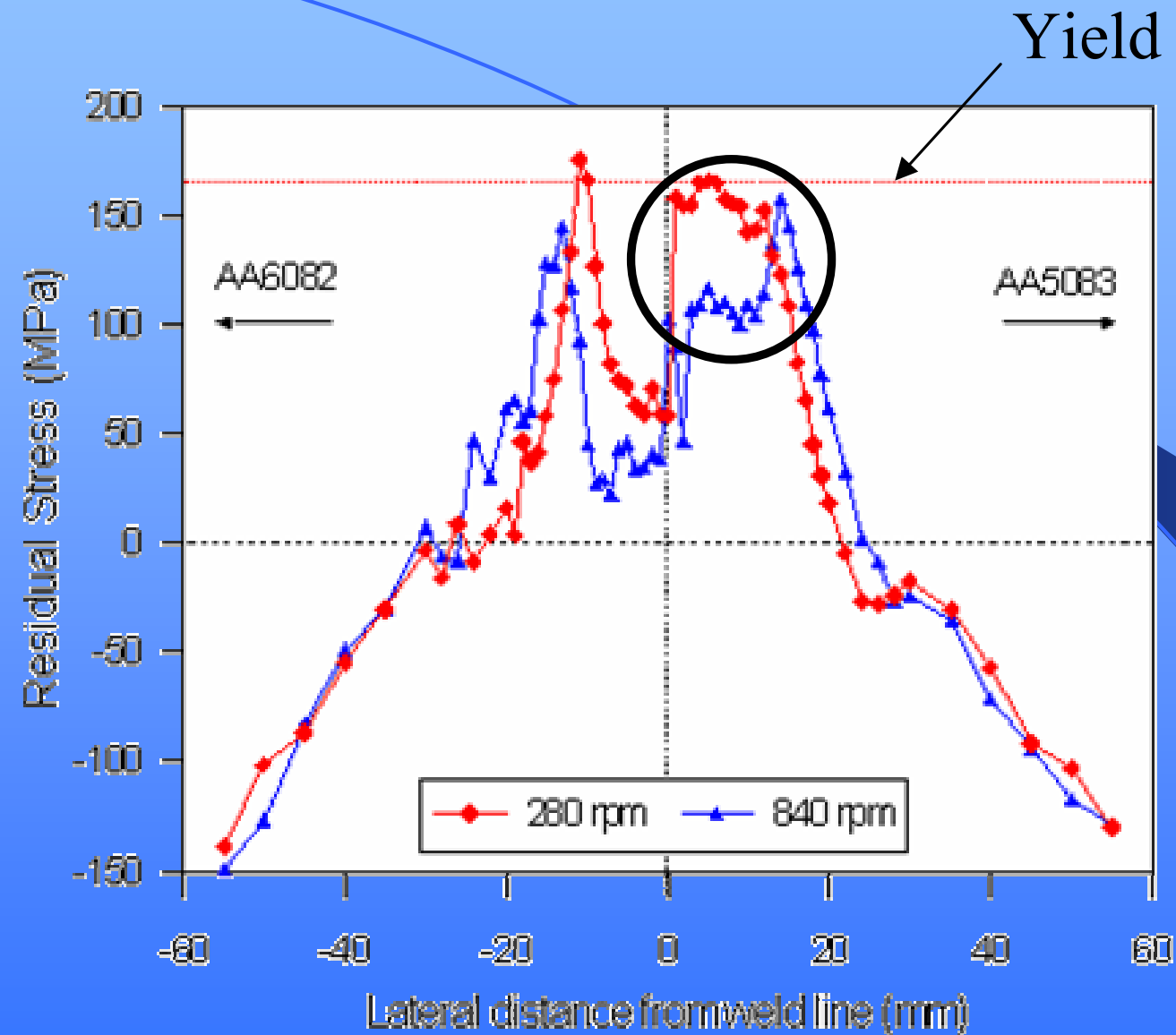


Shinkansen (Japan)



Space Shuttle

Stress Engineering

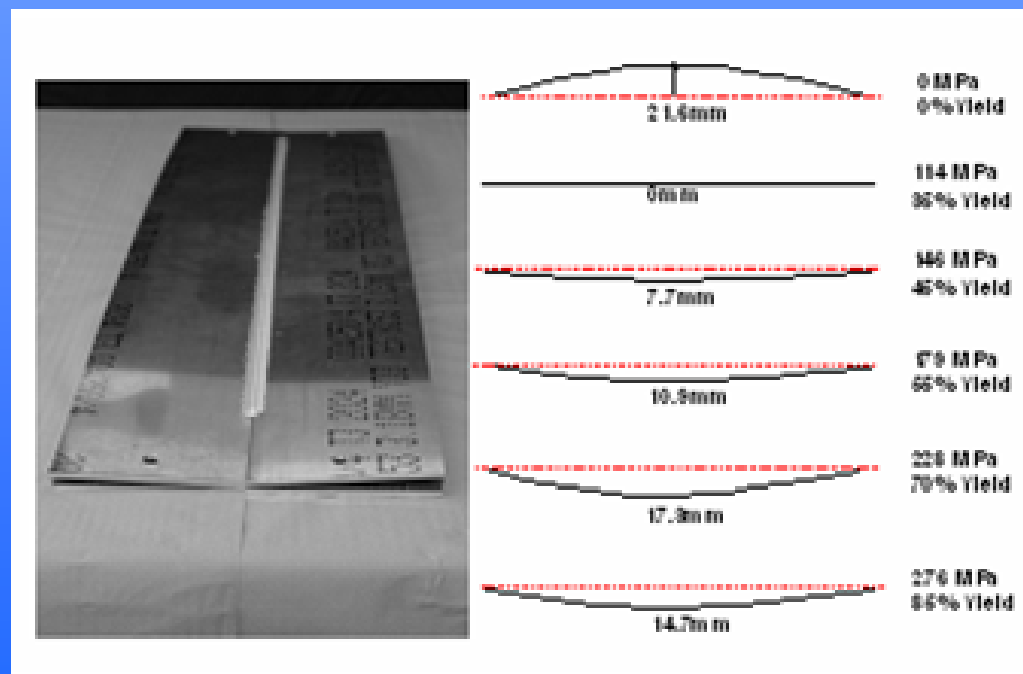


- Peak stress close to yield stress
- Change in distribution with rotation speed

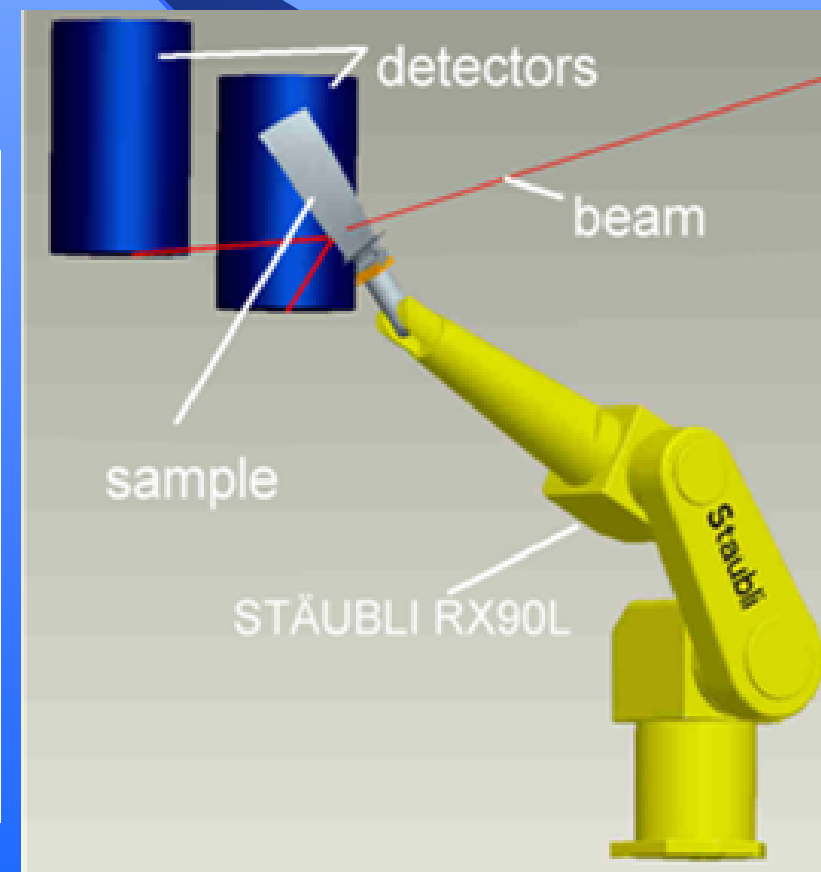
- Application of mechanical load during welding changes stress distribution

Goals

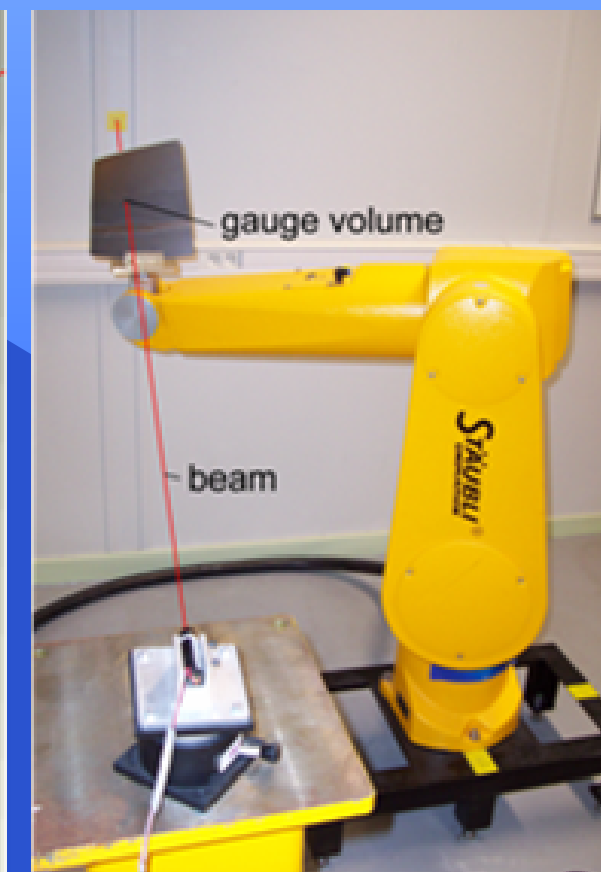
- Investigate matrix of samples for better understanding of residual stress
- Gain control over residual stress distribution
- Bragg-Diffraction (Neutrons and X-ray), mechanical properties and microstructure, FEM
- Advanced robotic based sample manipulation technique



Distorted FSW



Virtual model of RX90L



Lab simulation