Fatigue Analysis of Steels used in Offshore Structures Subjected to Variable Amplitude Load Conditions

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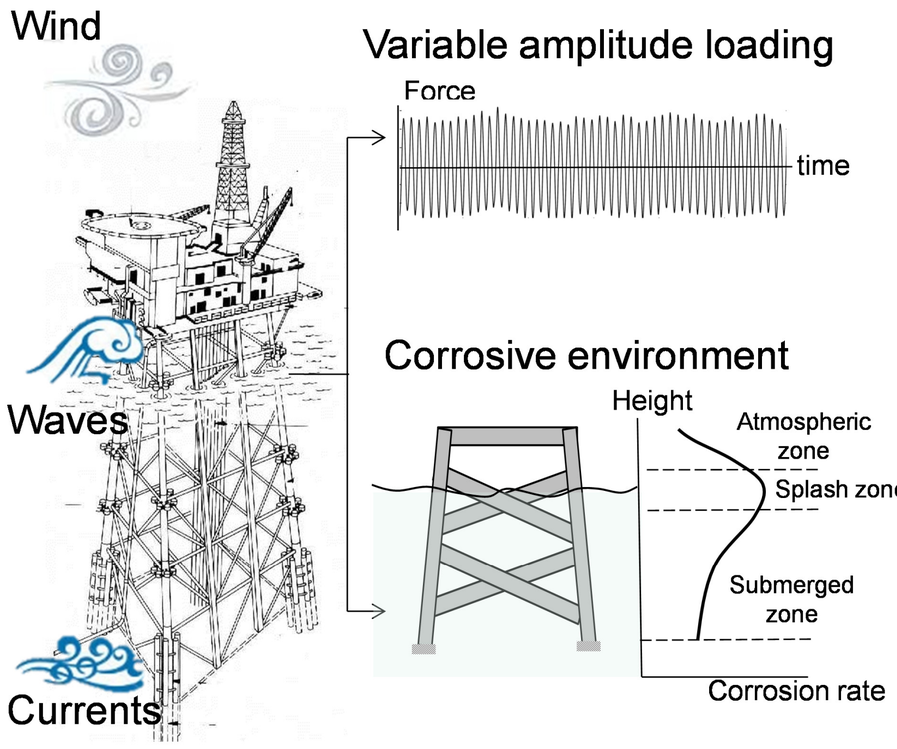


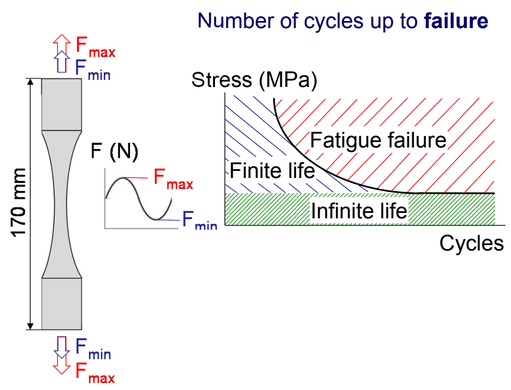
Offshore industry is growing fast. Since new generation steels and design techniques are not updated in the standards, designs can be over conservative.

Two high strength low alloy steels (yield stress of 520 and 610 MPa) are tested in "realistic" conditions (variable amplitude loads and corrosive environment).

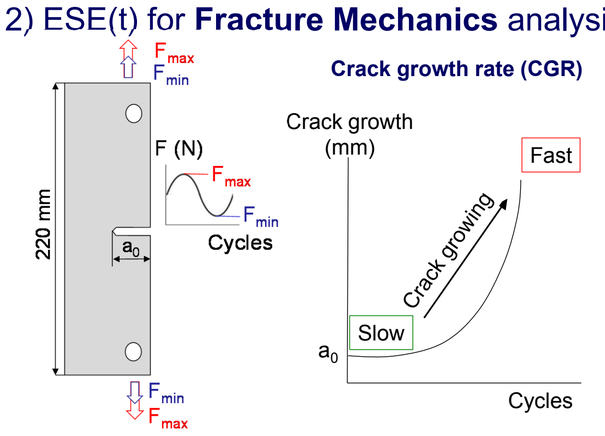
Basic fatigue properties

Two types of specimens are evaluated:

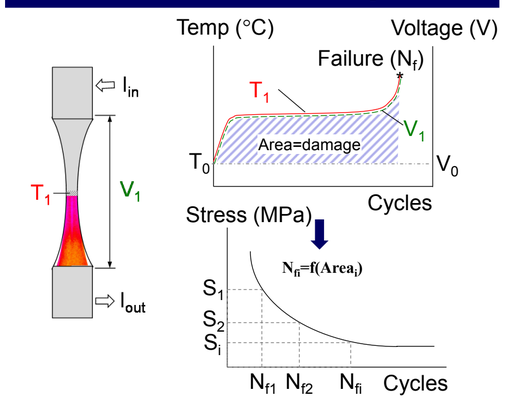
1) Round bar for **S-N** curve analysis:



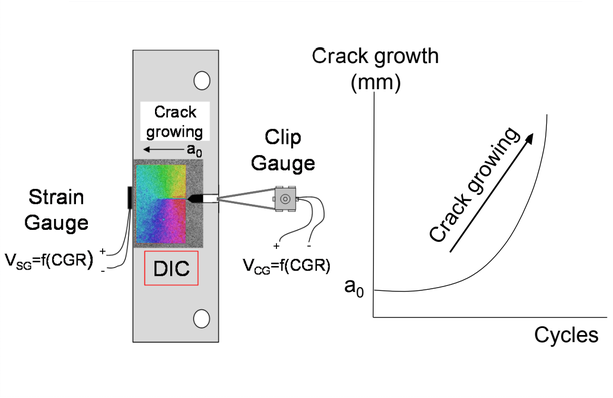
2) ESE(t) for **Fracture Mechanics** analysis:



Infrared & Potential Drop

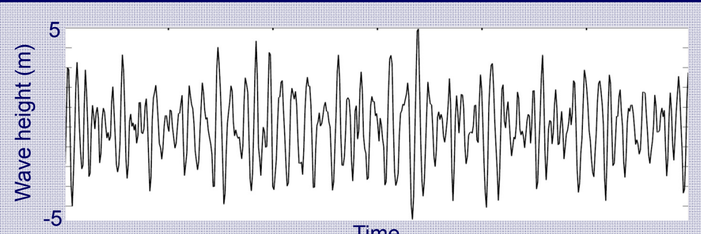


Digital Image Correlation & Electrical Measurements

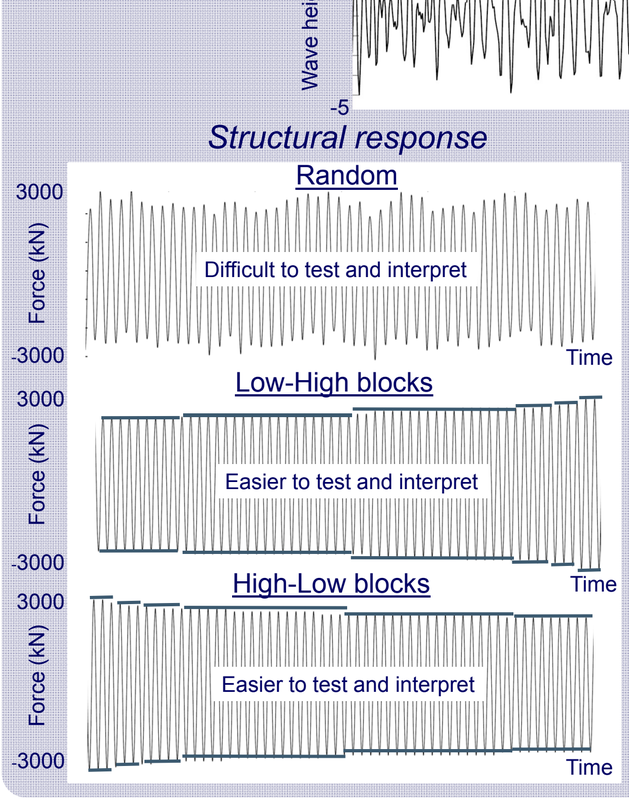


Variable amplitude (VA) analysis is more accurate

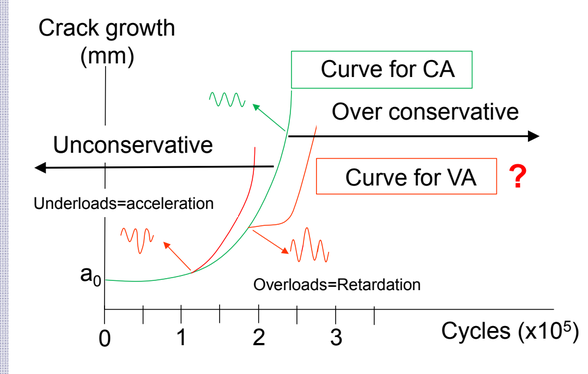
Wave spectrum



Structural response

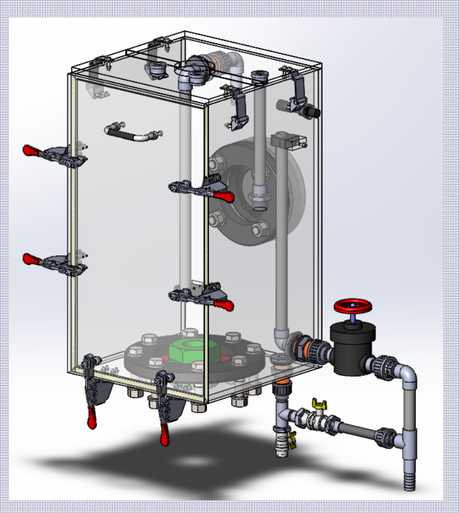


Analysis

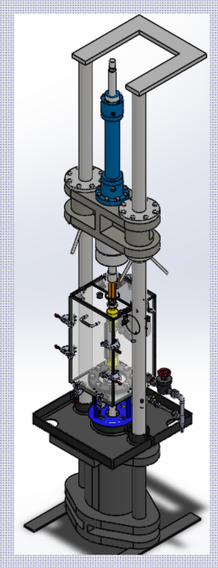


Corrosive environment decreases fatigue life

Seawater is corrosive and accelerates the fatigue proccess. An environmental chamber was built to test fatigue in a realistic corrosive situation.



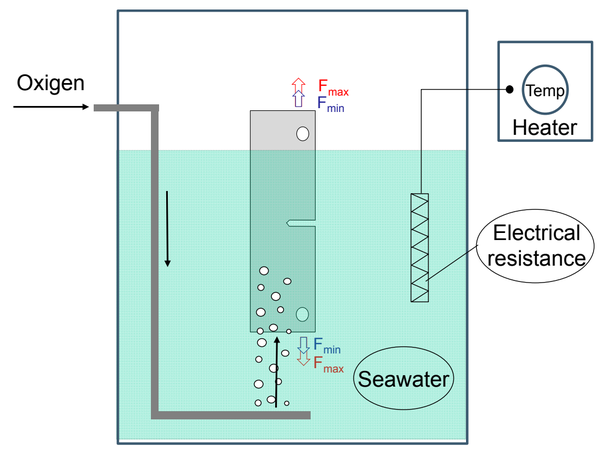
Corrosion chamber



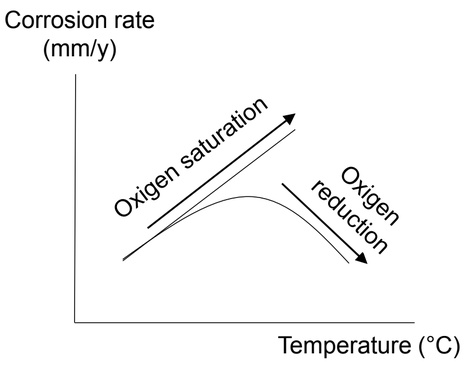
Tensile testing machine

Corrosion is a **slow process** and must be accelerated to allow an increased fatigue testing frequency.

Accelerated corrosion test setup

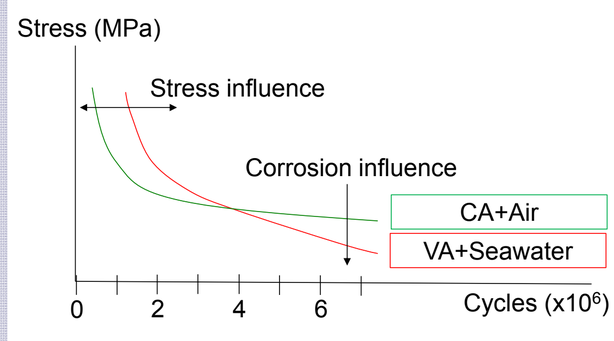


Physical kinetics analysis

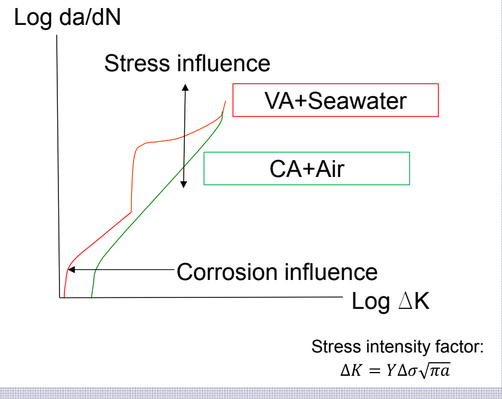


Possible corrosion-fatigue interaction

S-N



Fracture mechanics



Stress intensity factor: $\Delta K = Y\Delta\sigma\sqrt{\pi a}$

Realistic test conditions give accurate predictions.
VA loading can accelerate/retard the CGR.
Corrosion might be the driven damage mechanism at low stress levels

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