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# A method for corrosion-fatigue life prediction

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# A METHOD FOR

**Western Michigan University**  
**Kalamazoo, MI 49008-5343, USA**

# **CORROSION - FATIGUE LIFE**

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**Daniel Kujawski and Zahra Salemi**

# PREDICTION

**Mechanical and Aerospace Engineering**

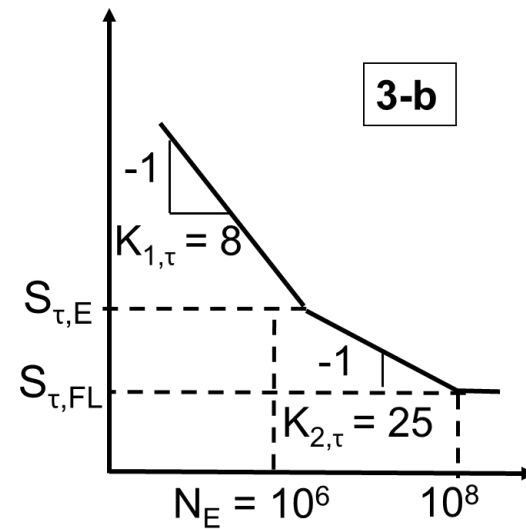
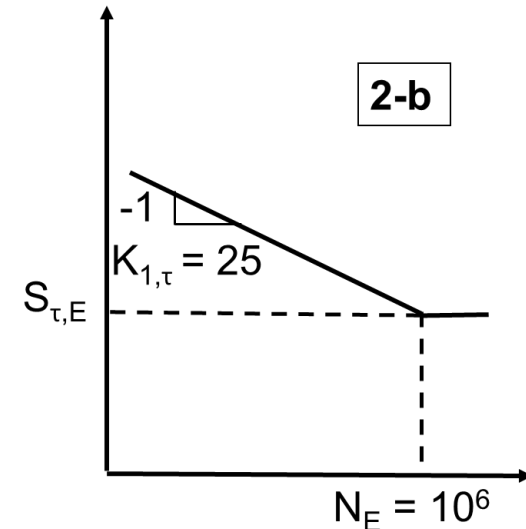
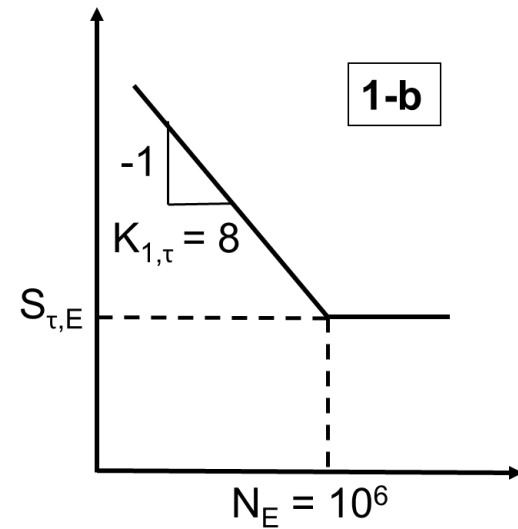
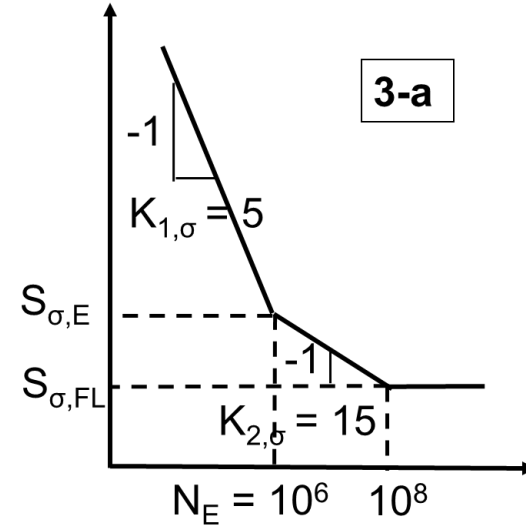
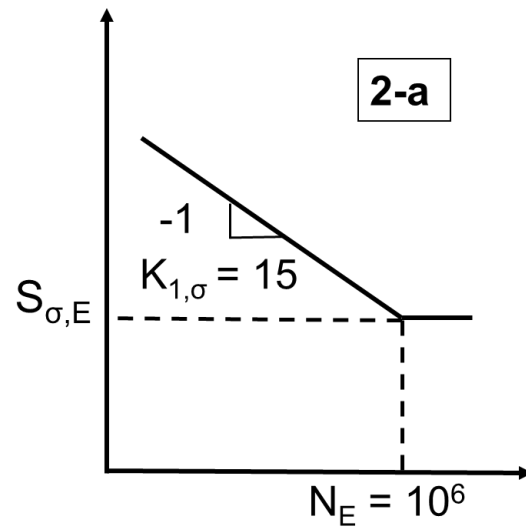
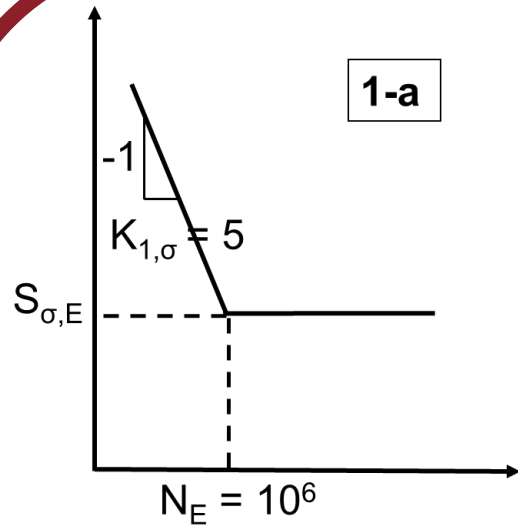
## ABSTRACT

This paper presents a method and strategy to predict/estimate fatigue life in terms of S-N curves for different material/environment systems. It is proposed that in dry air environment the stress amplitude corresponding to the endurance limit at  $2N_f = 2 \times 10^6$  and an intermediate life of  $2N_f = 2 \times 10^3$  reversals can be estimated from the ultimate strength,  $\sigma_u$ . The proposed method is compared with the well-established German FKM method. For corrosion-fatigue the proposed strategy requires the S-N curve in air and the corresponding  $k_{corr}$  factor at the endurance limit. Experimental data for selected steel, aluminum, and titanium alloys are used to illustrate and validate the proposed methodology. A fairly good agreement is demonstrated for vacuum, air and 3.5% NaCl environments.

## GERMAN FKM GUIDELINE

### Endurance Limit Factor For Various Materials

Material Type	$C_{\sigma,E}$
Case Hardening Steel	0.4
Stainless Steel	0.4
Forging Steel	0.4
Steel Casting	0.34
Other Types of Steel	0.45
Ductile Iron	0.34
Malleable Cast Iron	0.30
Gray Cast Iron	0.30
Wrought Aluminum Alloys	0.30
Cast Aluminum Alloys	0.30



1) Surface non-hardened components made of steels and cast irons

2) Surface hardened components made of steels and cast irons

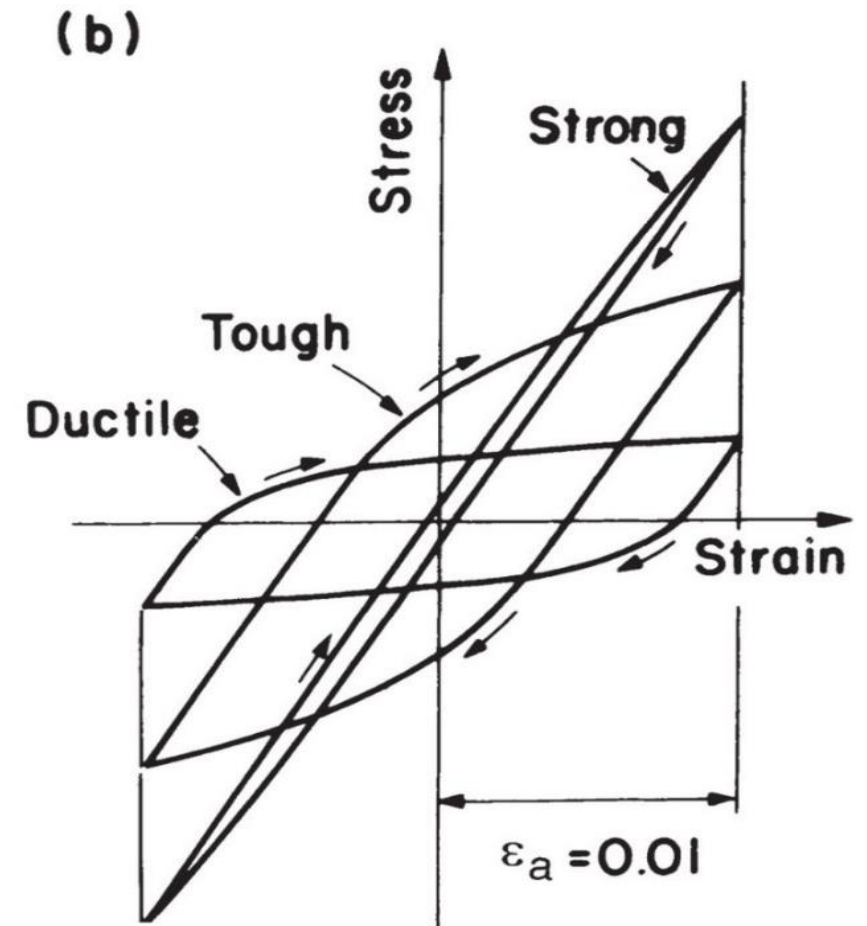
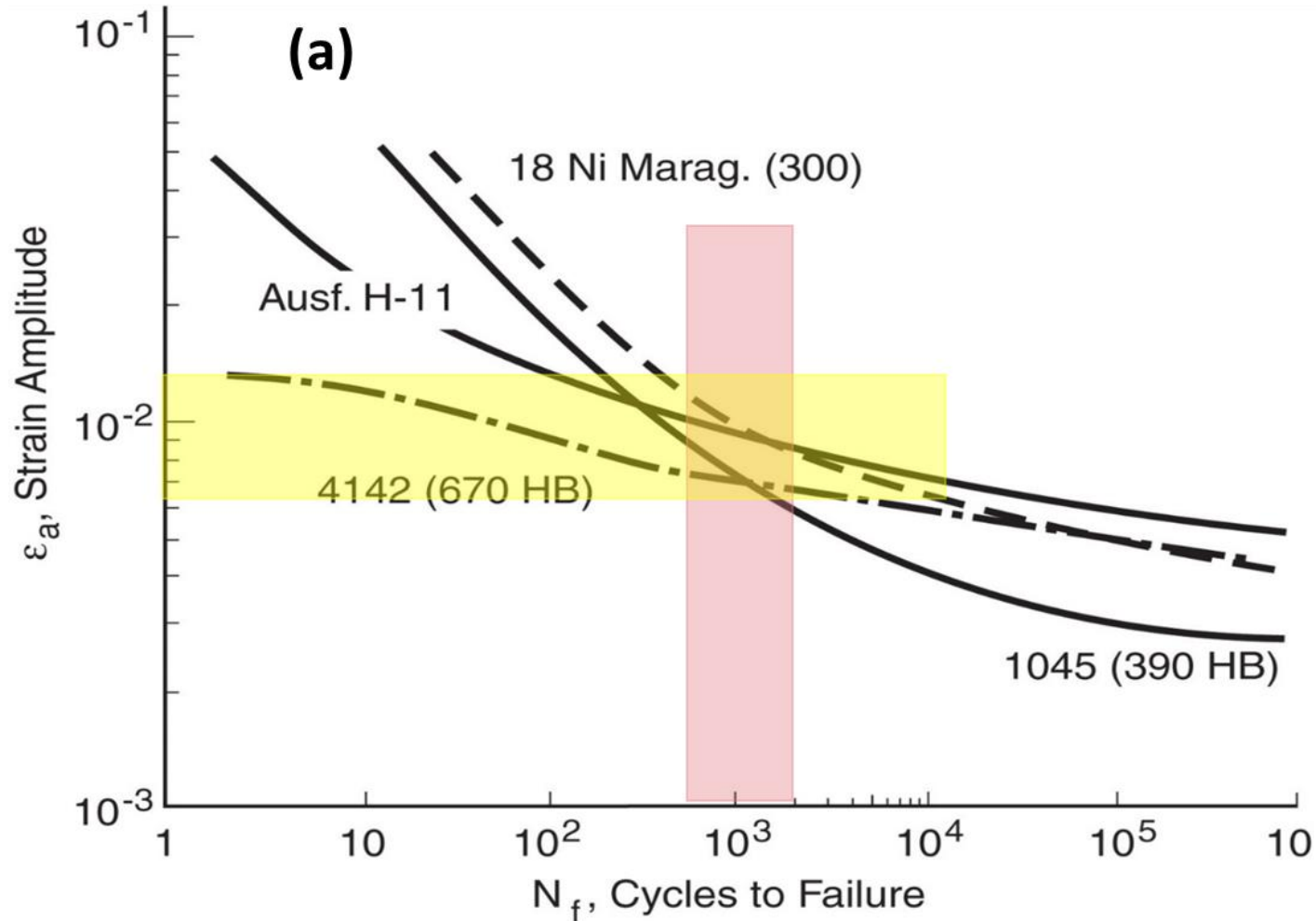
3) Components made of aluminum alloys and austenitic steels

**Synthetic Components**  
Constant Amplitude S-N  
Curves for Different  
Materials

# TRENDS IN STRAIN-LIFE CURVES

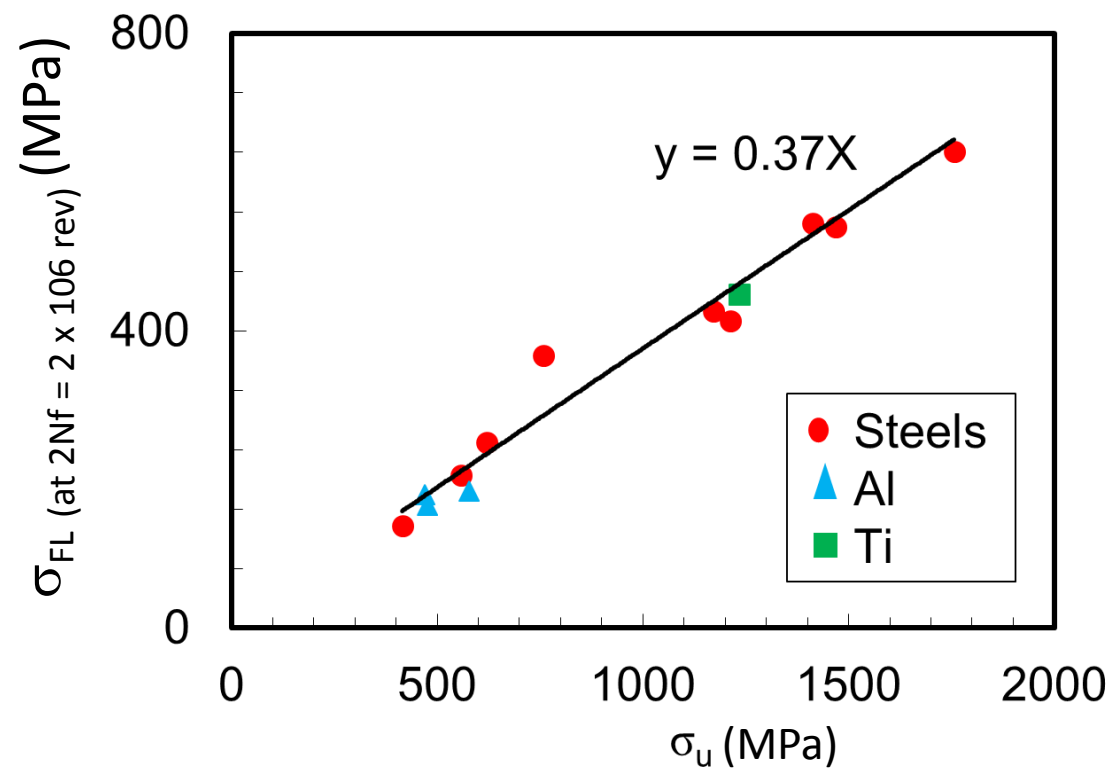
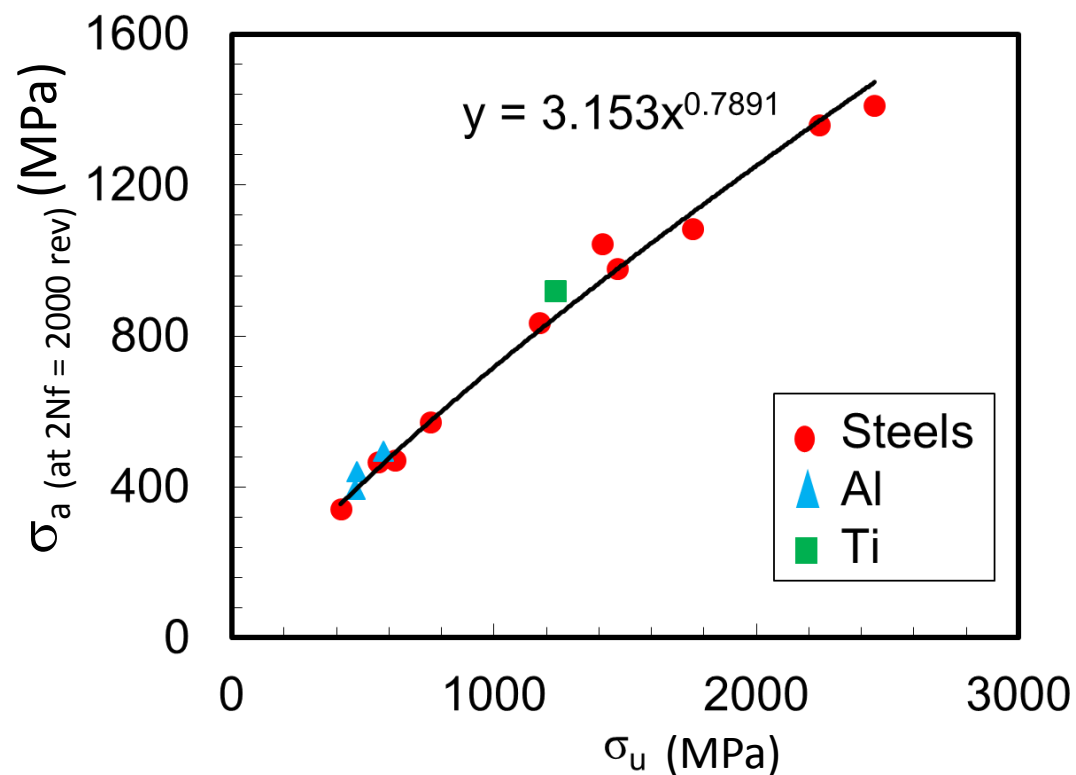
for strong, tough, and ductile materials

Landgraf (1970) (Adopted from Dowling book)

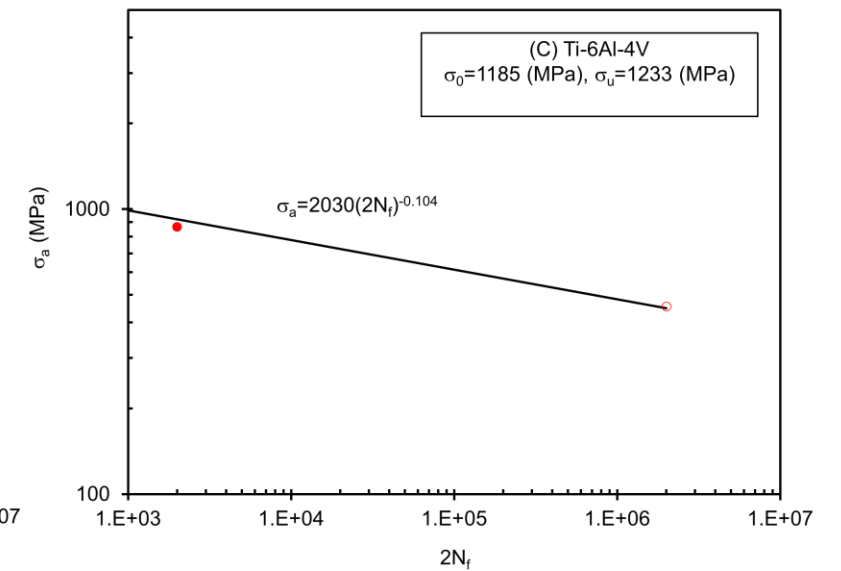
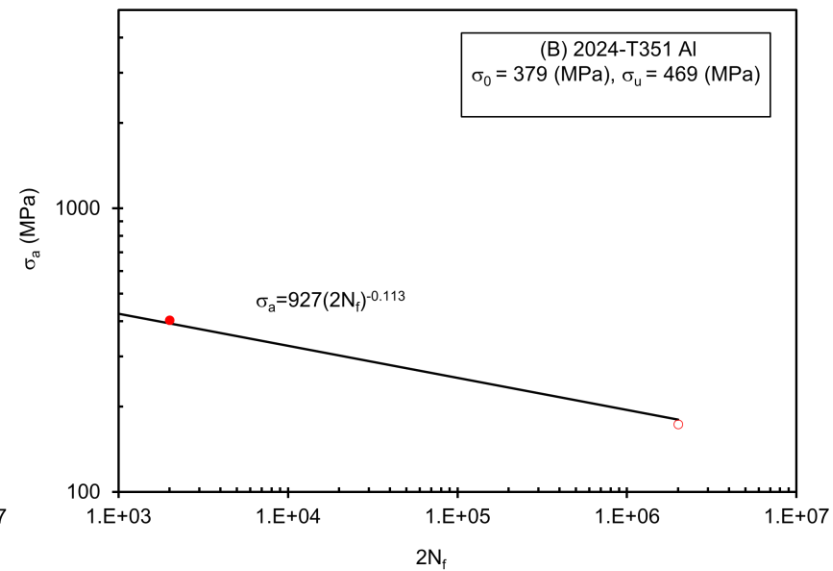
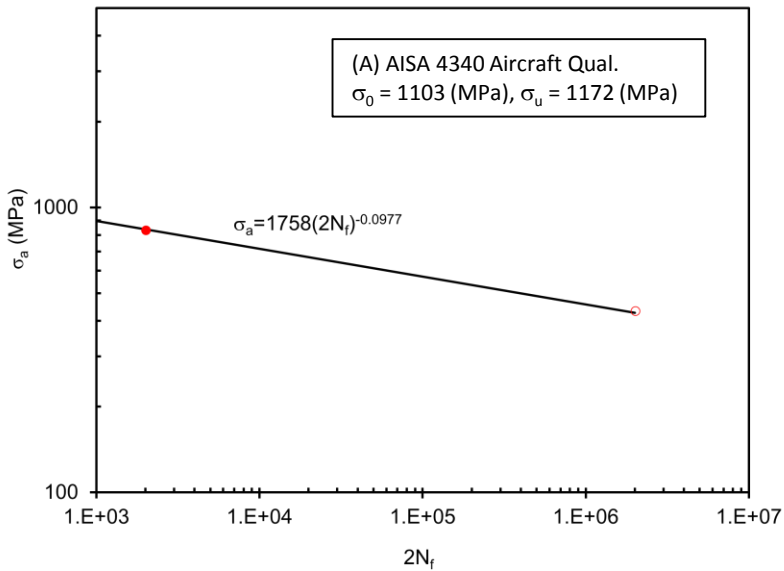




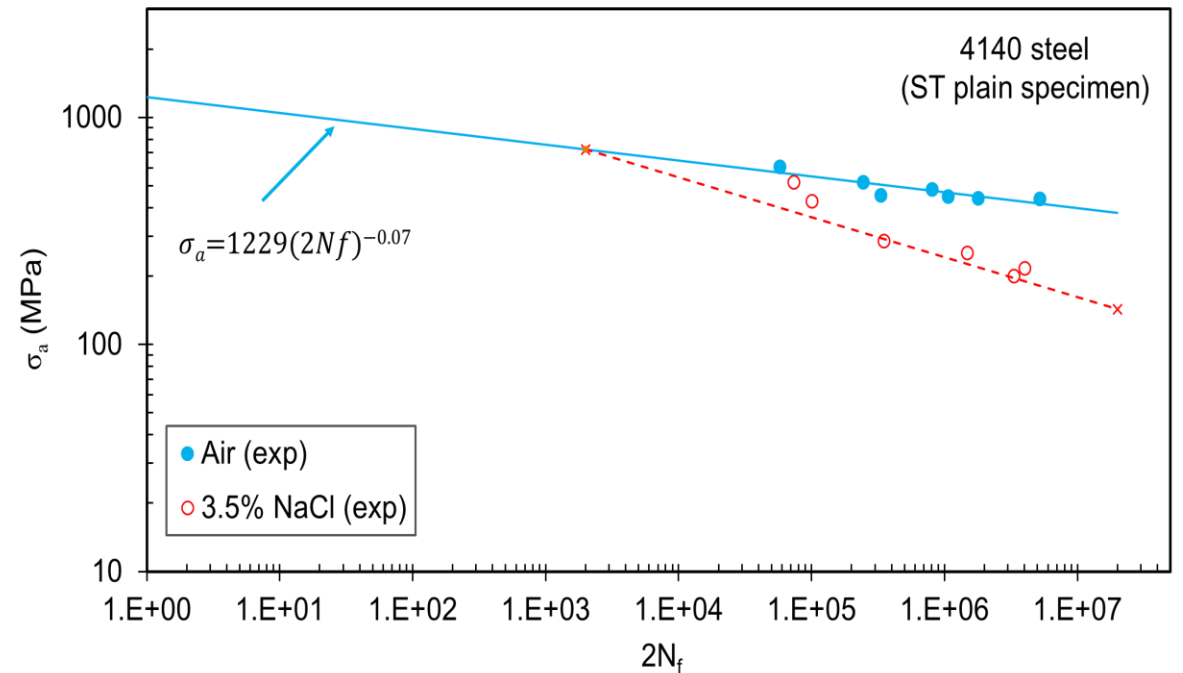
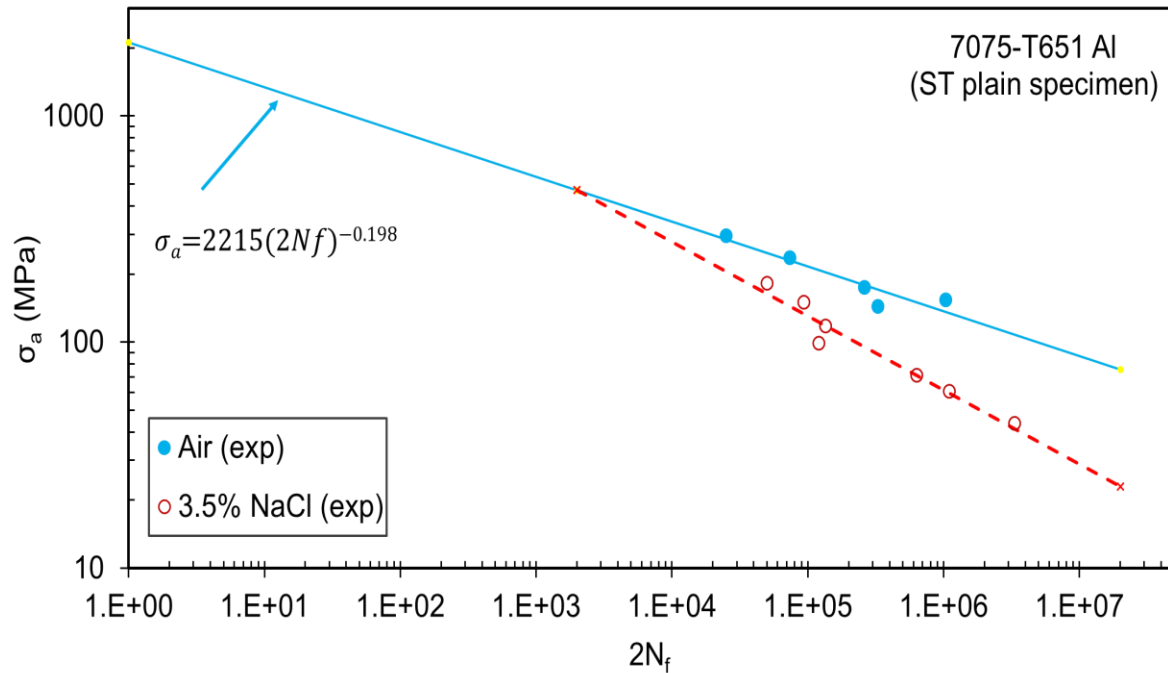
## PROPOSED APPROACH

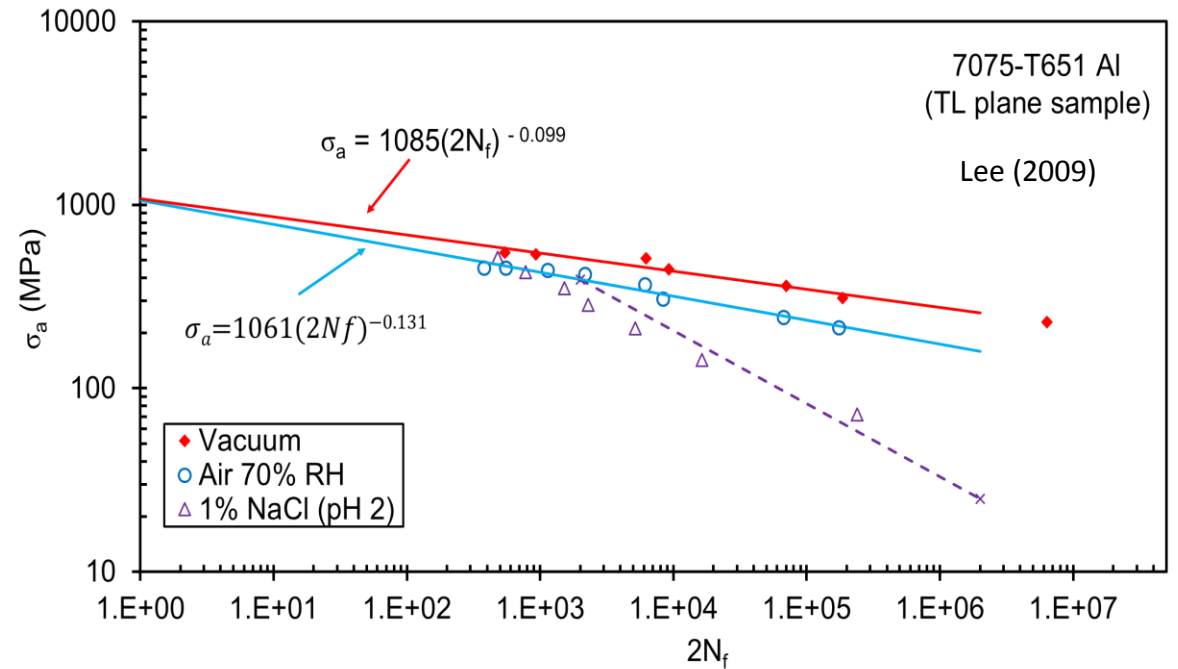
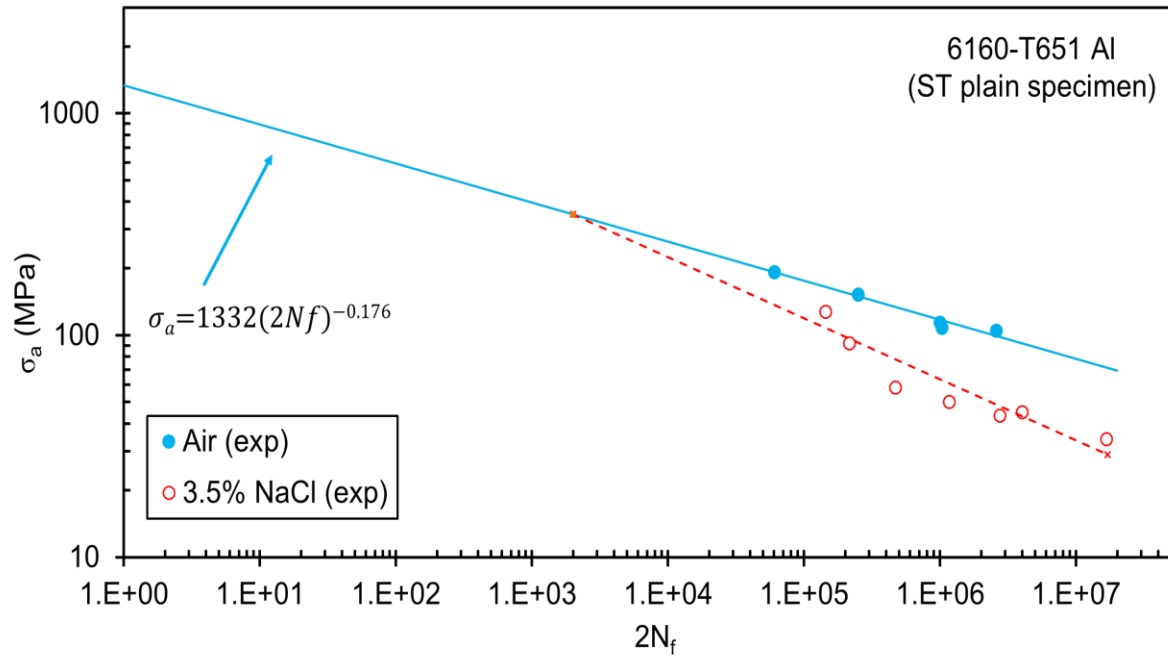


# ESTIMATED S-N CURVE FOR THREE DIFFERENT TYPES OF MATERIAL

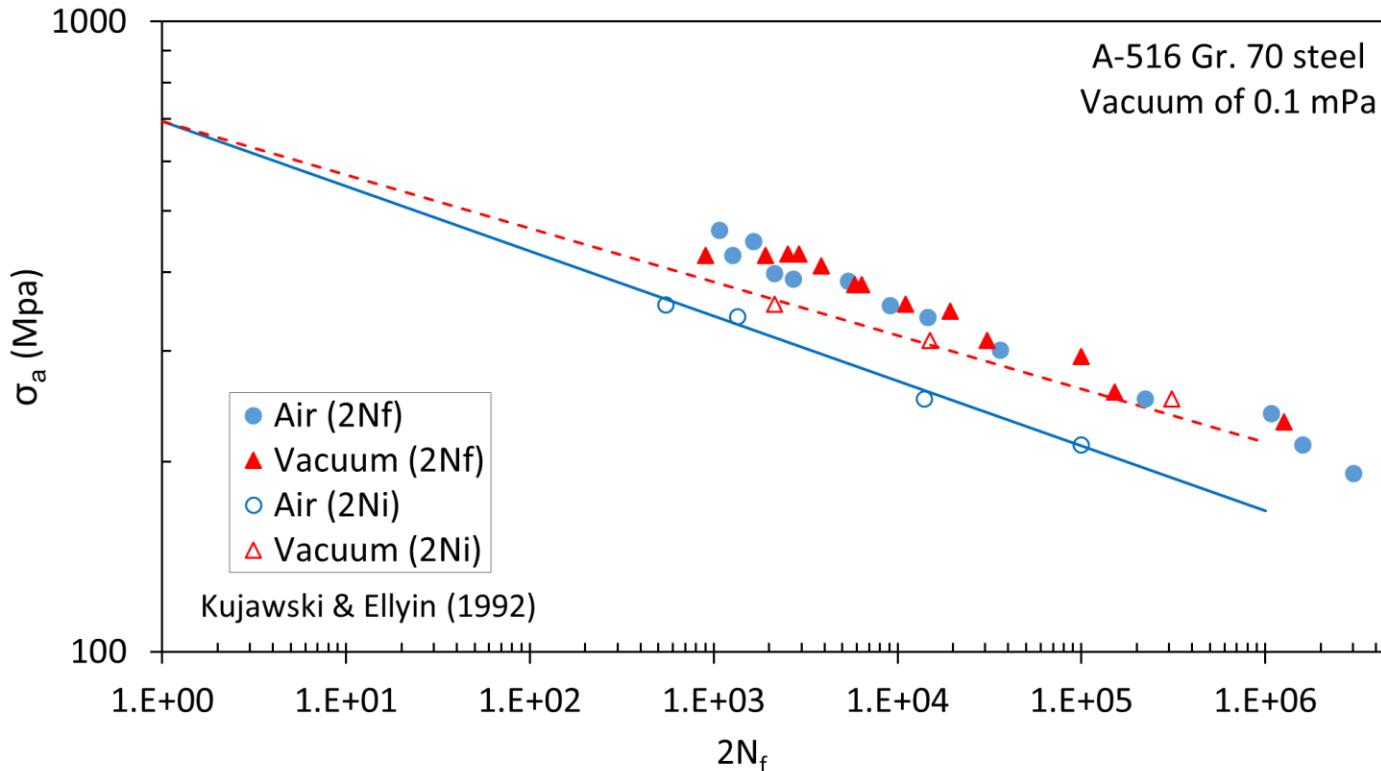


# S-N CURVE OF DIFFERENT ENVIRONMENT





# CRACK INITIATION AND TOTAL FATIGUE LIFE IN VACUUM AND AIR



## CONCLUSION :

1. A strategy to predict fatigue life in terms of S-N curves for different material/environment systems has been proposed.
2. A fairly good agreement is demonstrated for vacuum, air and NaCl environments.

## ACKNOWLEDGMENT :

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