Fracture and Fatigue Assessments of Marine Pipelines and Subsea Components

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Seguir

Professor of Strutural Engineering, University of São Paulo
Fracture Mechanics, Structural Integrity Methodologies, Fatigue, Local Approaches for Brittle and Ductile Fracture
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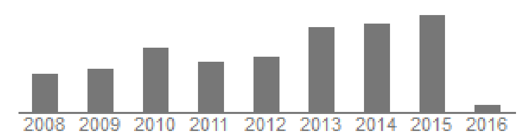
Índice i10	36	23



Título 1–20	Citado por	Ano
Calibration of Weibull stress parameters using fracture toughness data X Gao, C Ruggieri, RH Dodds Jr International Journal of Fracture 92 (2), 175-200	217	1998
Numerical modeling of ductile crack growth in 3-D using computational cell elements C Ruggieri, TL Panontin, RH Dodds Jr	173	1996

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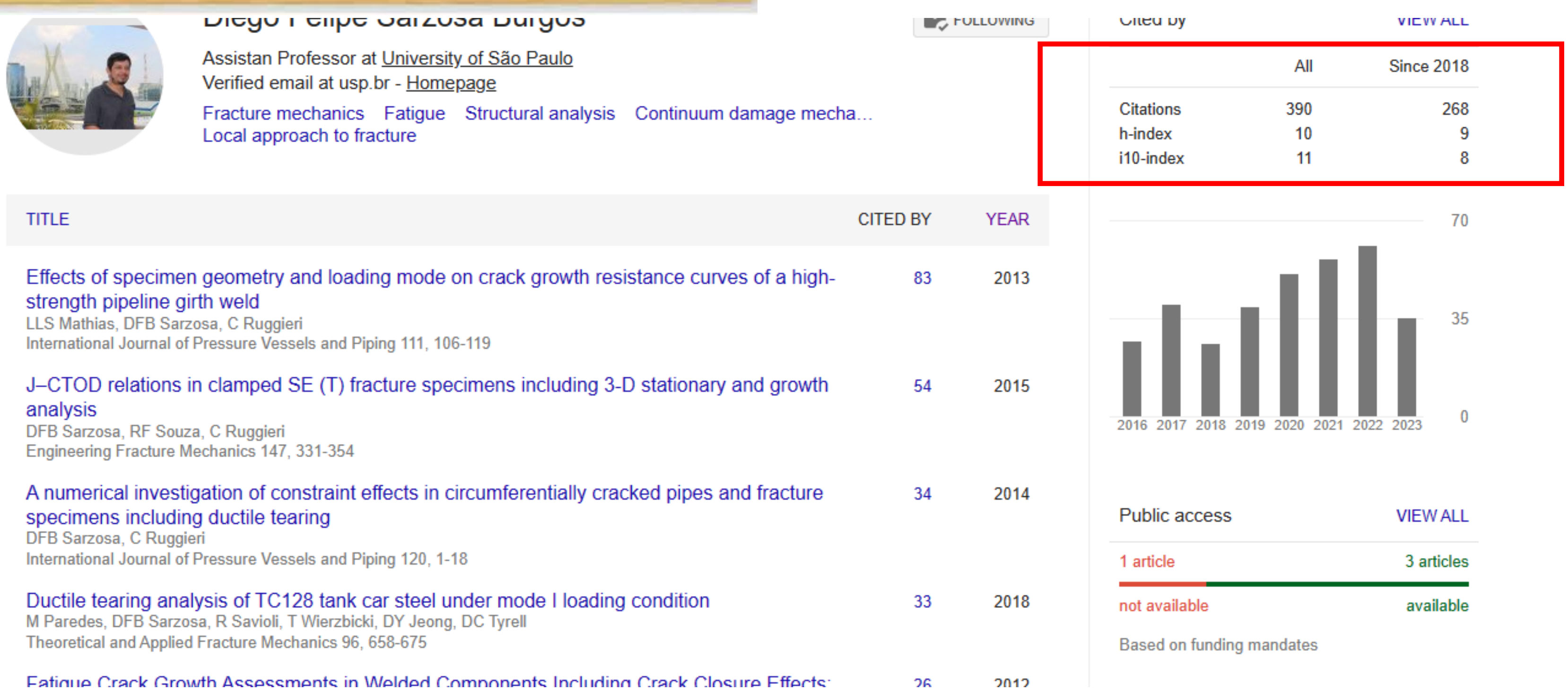

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FOLLOWING

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Fracture mechanics Fatigue Structural analysis Continuum damage mecha… Local approach to fracture

TITLE	CITED BY	YEAR
Effects of specimen geometry and loading mode on crack growth resistance curves of a high-strength pipeline girth weld LLS Mathias, DFB Sarzosa, C Ruggieri International Journal of Pressure Vessels and Piping 111, 106-119	83	2013
J–CTOD relations in clamped SE (T) fracture specimens including 3-D stationary and growth analysis DFB Sarzosa, RF Souza, C Ruggieri Engineering Fracture Mechanics 147, 331-354	54	2015
A numerical investigation of constraint effects in circumferentially cracked pipes and fracture specimens including ductile tearing DFB Sarzosa, C Ruggieri International Journal of Pressure Vessels and Piping 120, 1-18	34	2014
Ductile tearing analysis of TC128 tank car steel under mode I loading condition M Paredes, DFB Sarzosa, R Savioli, T Wierzbicki, DY Jeong, DC Tyrell Theoretical and Applied Fracture Mechanics 96, 658-675	33	2018
Fatigue Crack Growth Assessments in Welded Components Including Crack Closure Effects:	26	2012

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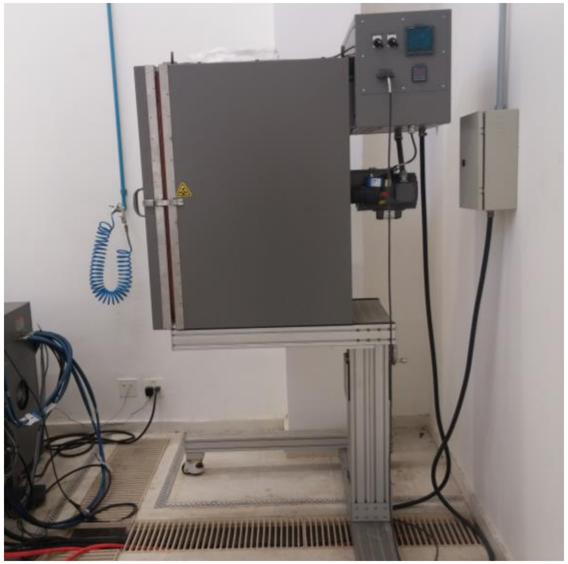
Experimental Facilities

- *TEST RIG:*
  - *Two MTS 250 kN*
  - *Chamber -50°C / 150 °C*



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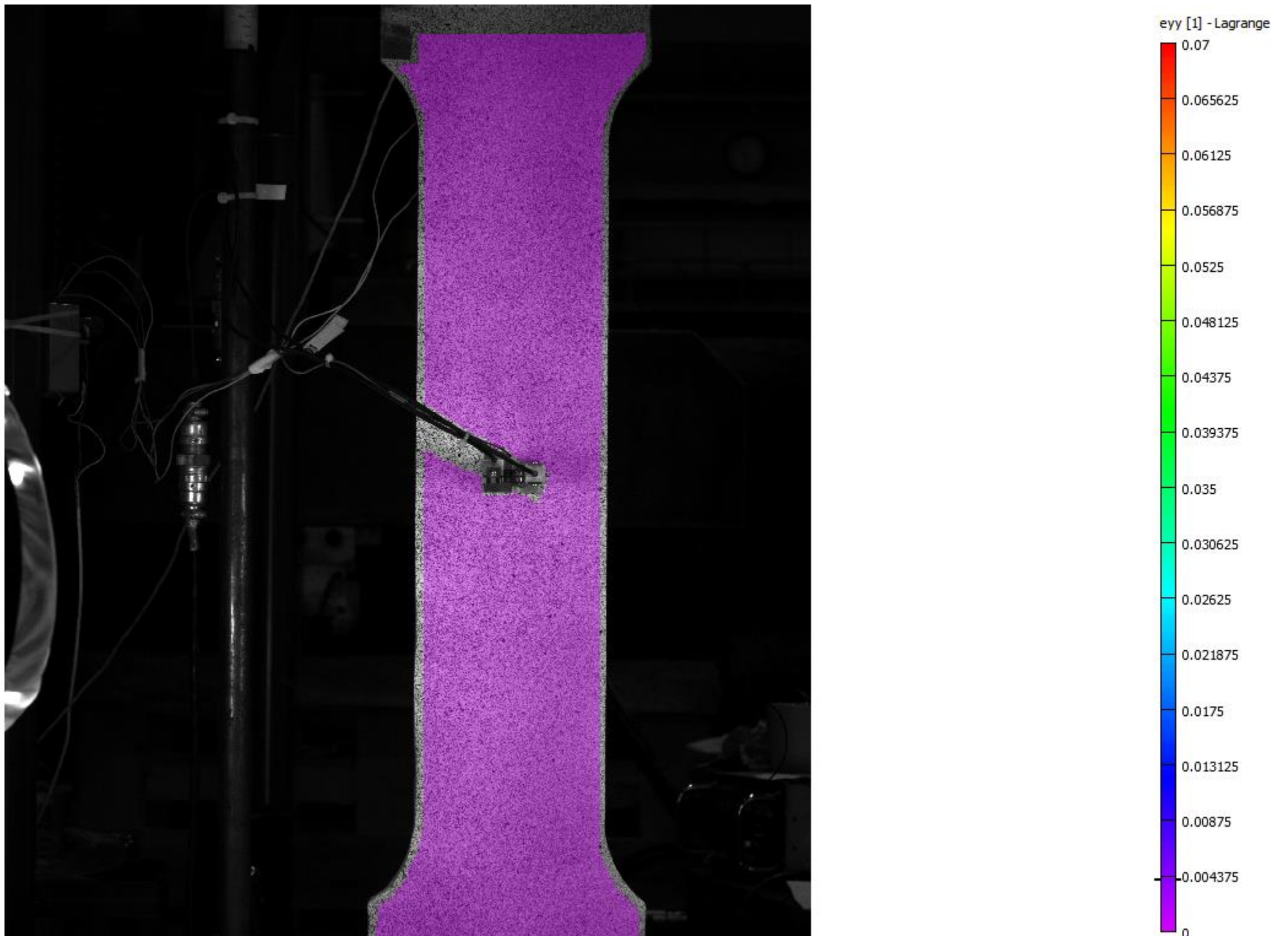
Experimental Facilities

- *Charpy Test*

Experimental Facilities

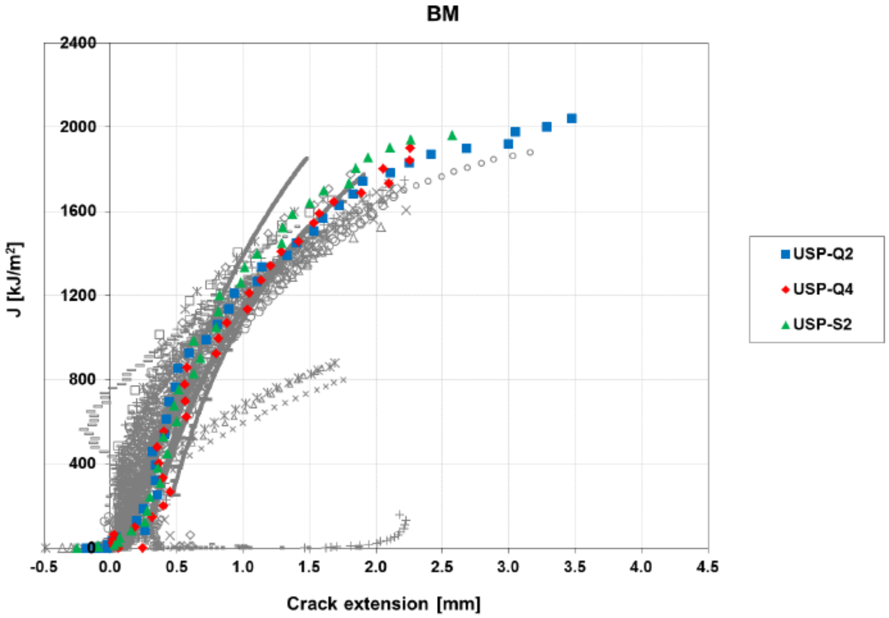
- *Digital Image Correlation System*



Experimental Facilities

International Cooperation

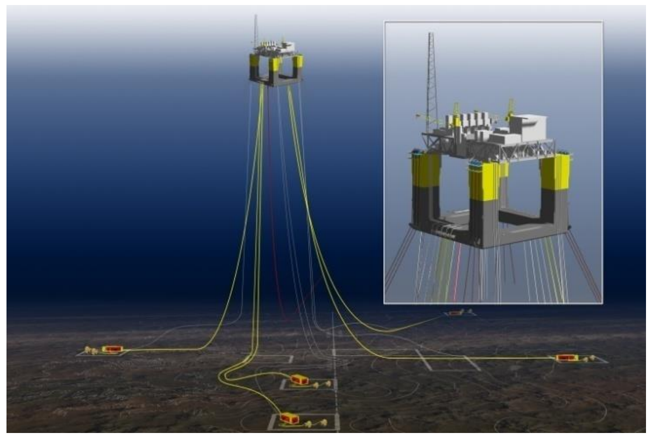
- *Gent University (**Belgium**)*
  - *Prof. Rudy Denis*
  - *Prof. Stijn Hertelé*
- *CANMET (**Canada**)*
  - *Dr. Bill Tyson*
  - *Round Robin Test SE(T) specimen*
- *BMT-Fleet Technology*
  - *Dr. Nick Pussegoda*
  - *Round Robin Test Part II:*
    - *SE(T) specimen Base, Welded and HAZ Metal*



Cooperation

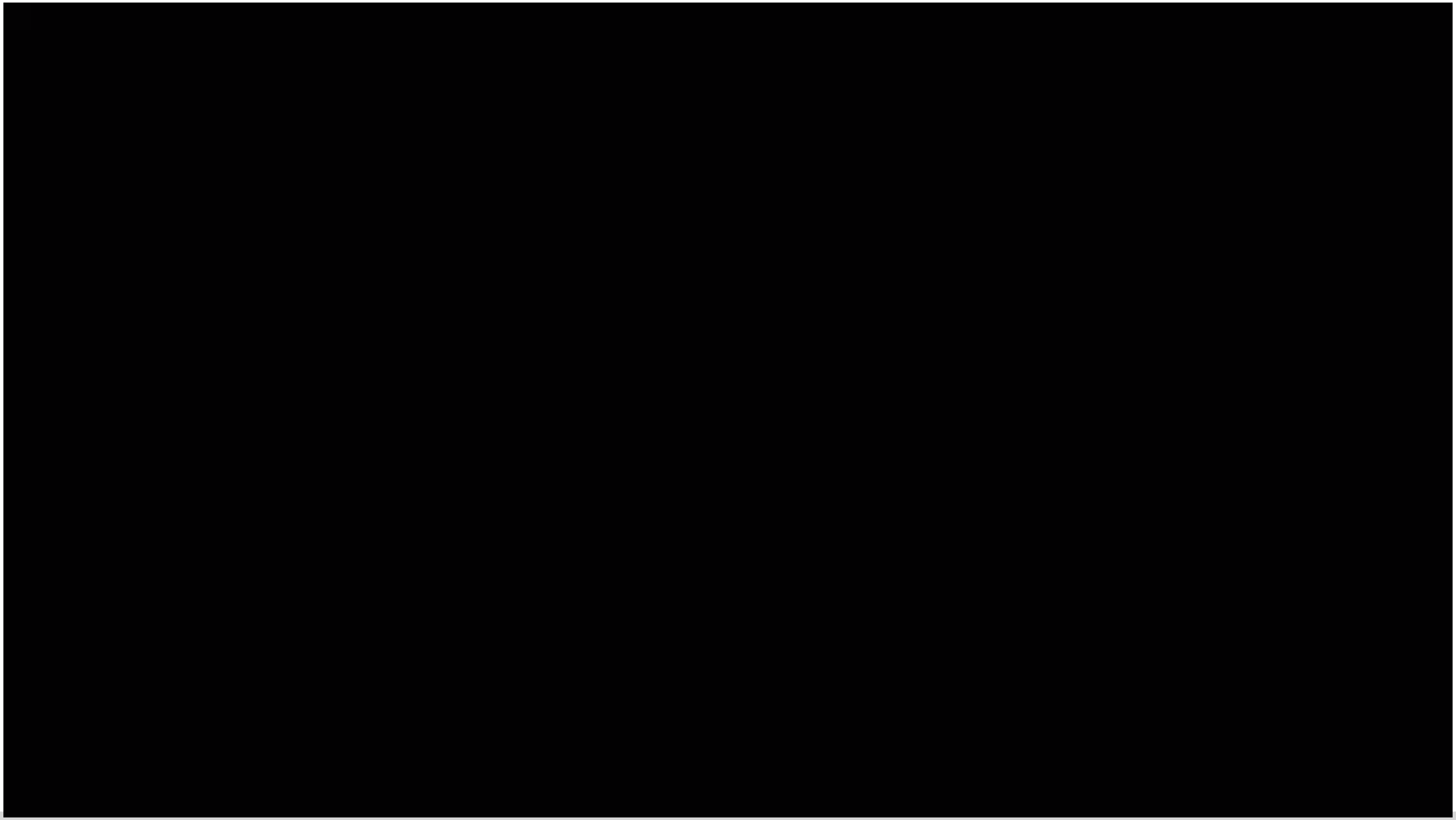
- *University of California (UCSB/**USA**)*
  - *Prof. G. R. Odete*
- *NTNU (**Norway**)*
  - *Prof. Zhang*
- *Limerick University*
  - *Prof. Noel O'Dowd*
- *Texas A&M University (TAMU/**USA**)*
  - *Prof. Marcelo Paredes*
- *ASTM Committee E08 on Fatigue and Fracture (Active Member)PARTICIPATING AS A MEMBER ON THE COMMITTEE*

Estruturas Críticas em Engenharia



Falhas Estruturais Tornaram-se Potencialmente Inevitáveis e Imprevisíveis!

Fratura Frágil vs. Dúctil



Navios *Liberty*

Navios *Liberty*

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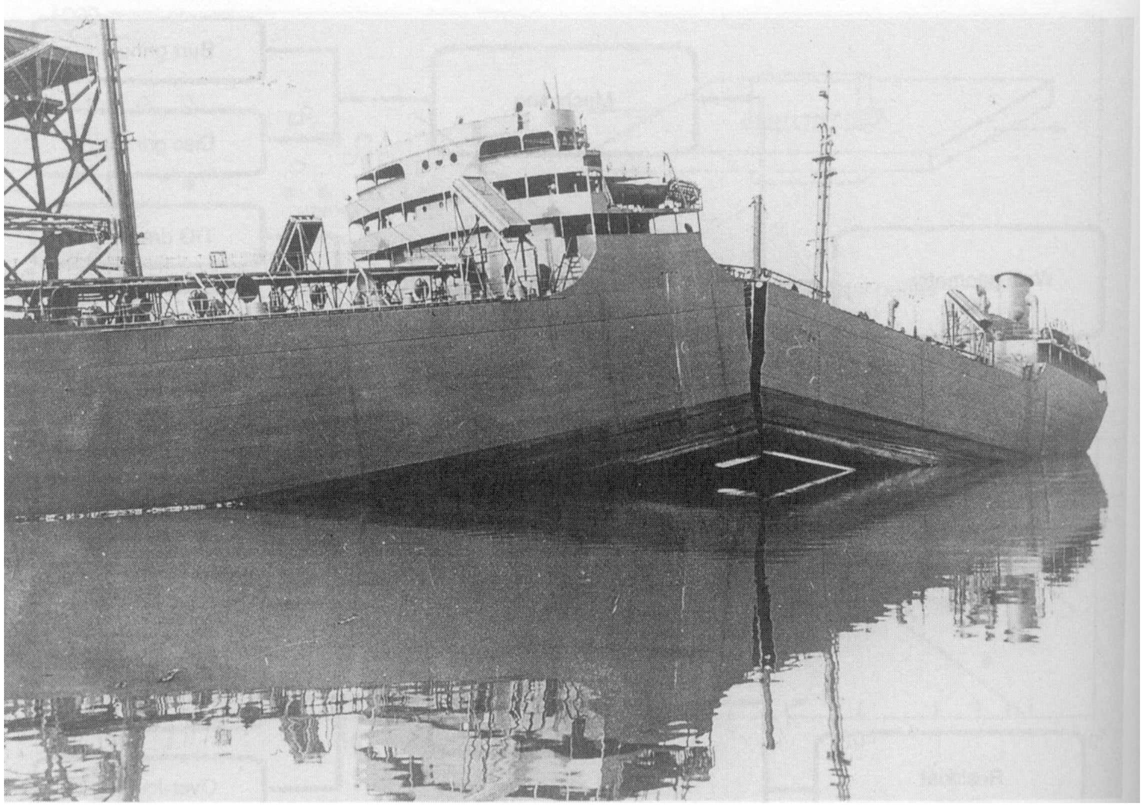

Vaso de Pressão

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Plataforma *Alexander Kielland*

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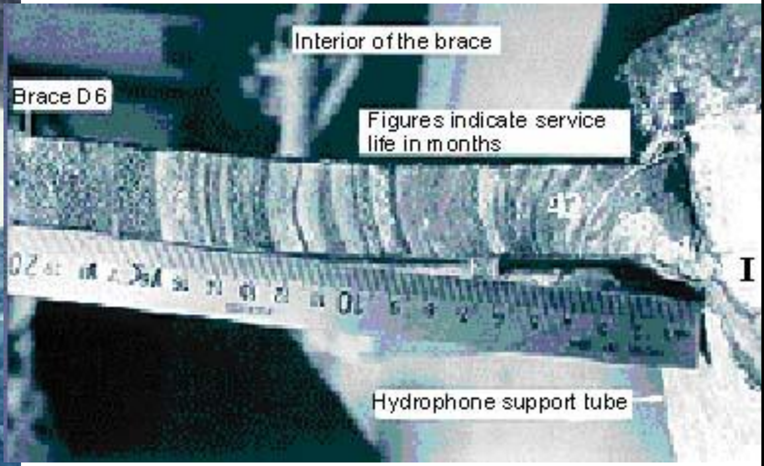
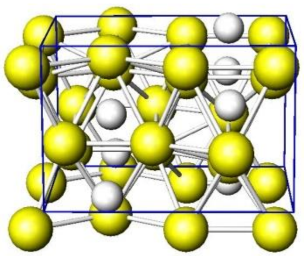


Colapso Catastrófico Precedido por Propagação de Defeito por Fadiga no Contraventamento

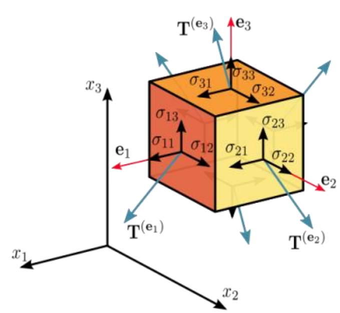
O QUE É INTEGRIDADE ESTRUTURAL?

Análise Experimental e Ensaios

Ciência e Engenharia de Materiais



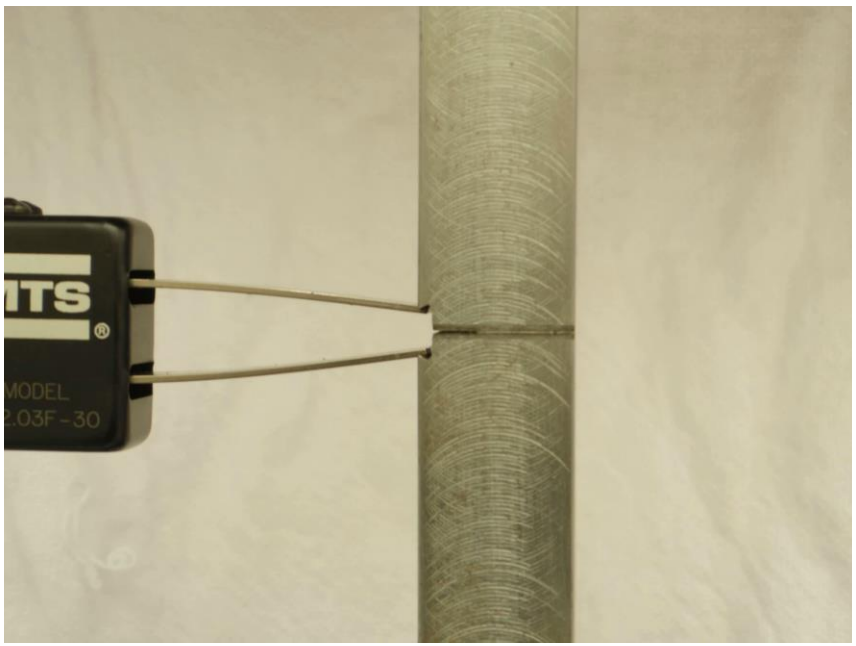
Mecânica Teórica, Analítica e Computacional

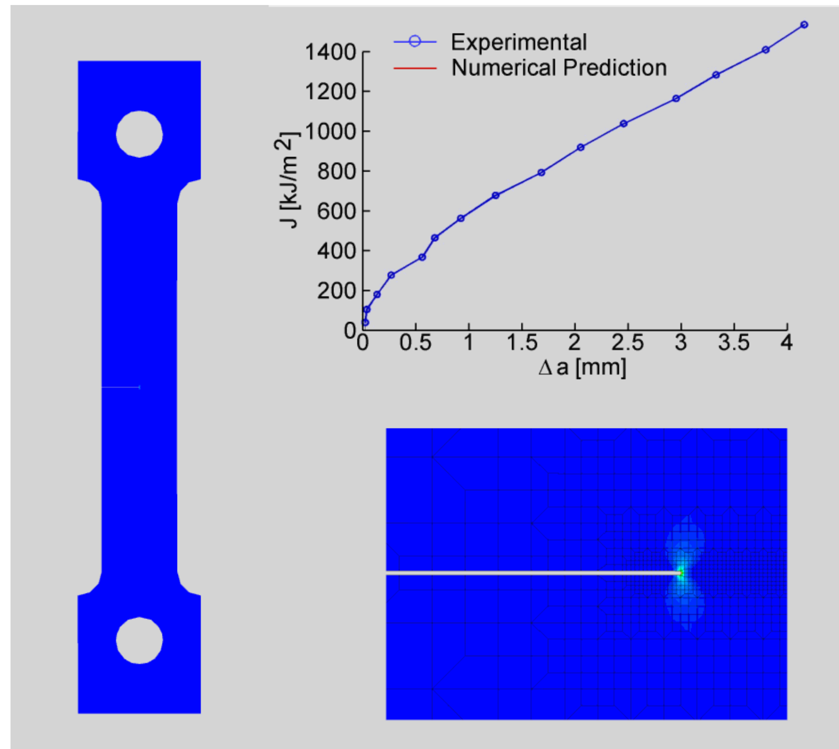


INTEGRIDADE ESTRUTURAL

- ***Segurança em Serviço***
- ***Avaliação de Defeitos (Vida Remanescente)***
- ***Extensão de Vida Útil***

Modelos Numéricos para Representar o Mundo Real





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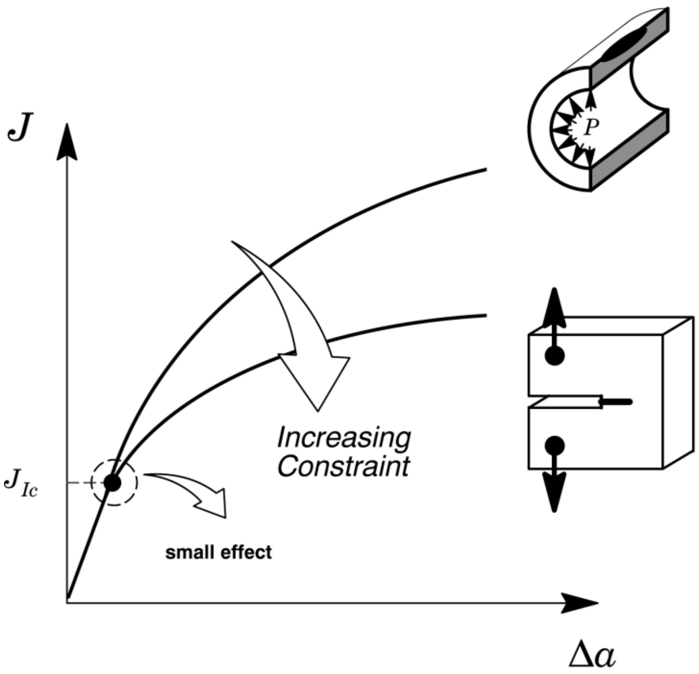
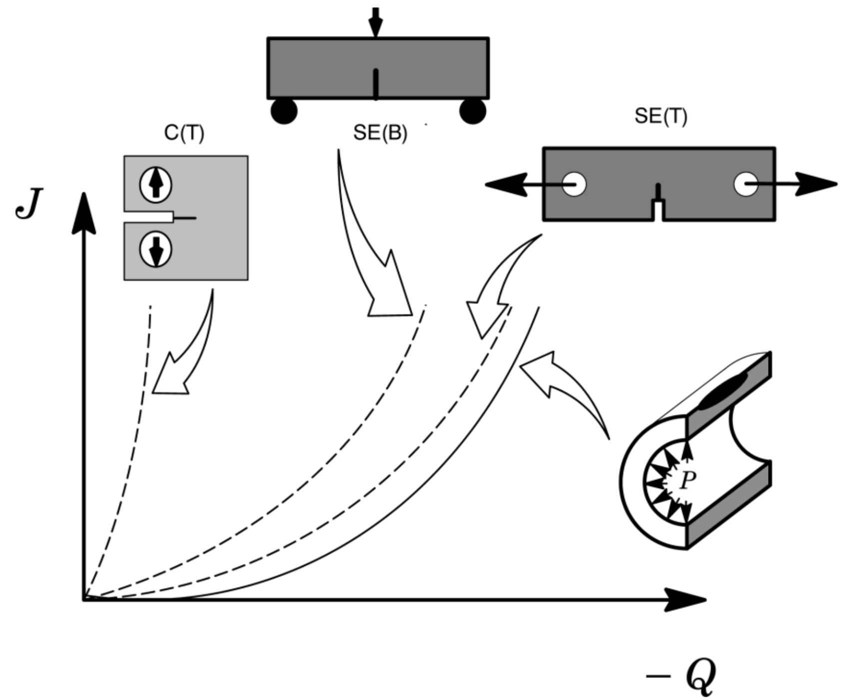
On-Going Work

- ***Ductil Fracture***

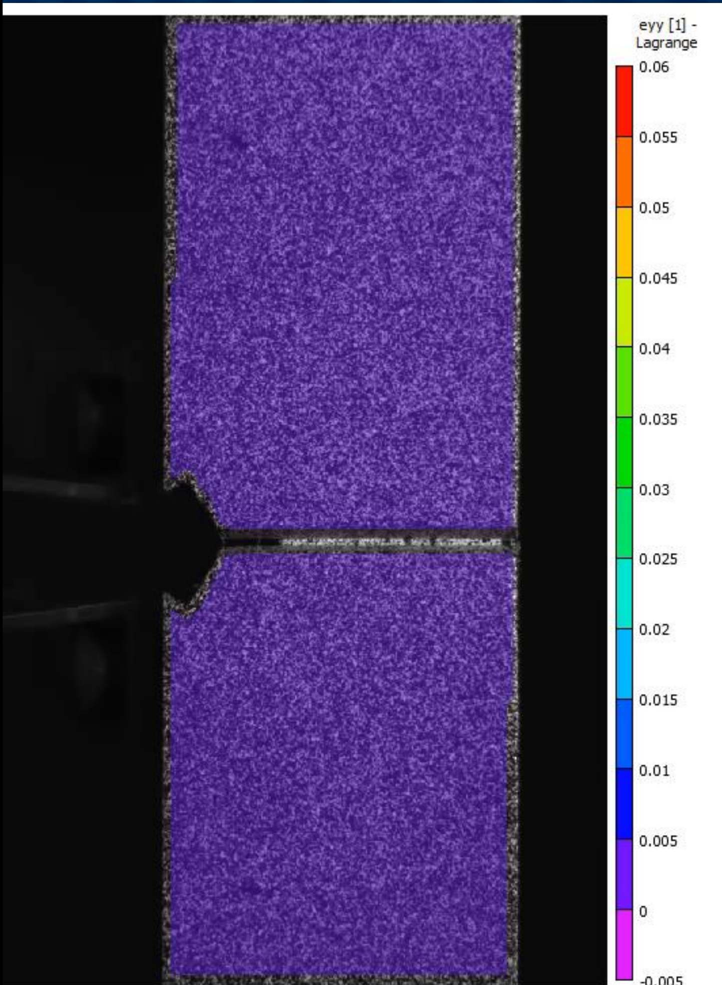
Constraint Effects in ECA Procedures

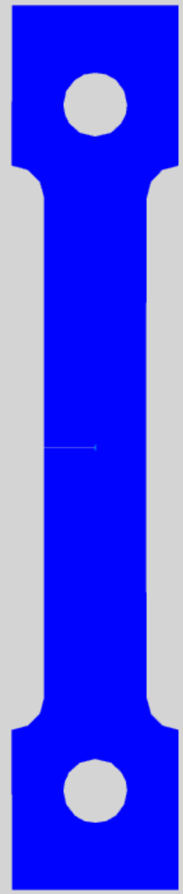


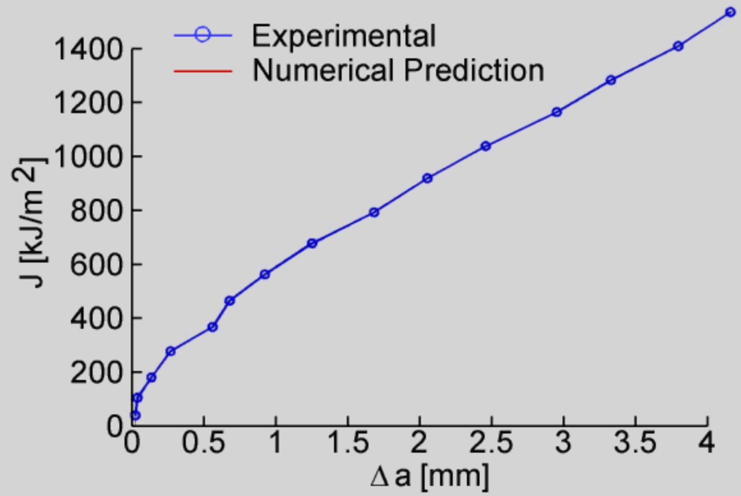


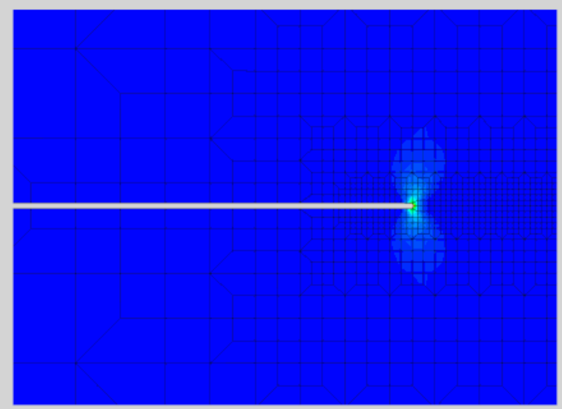
- ***Fracture Resistance is not a material property! It will depend on the Specimen Geometry and Loading Mode.***

Numerical Modeling Using GT Model









On-Going Work

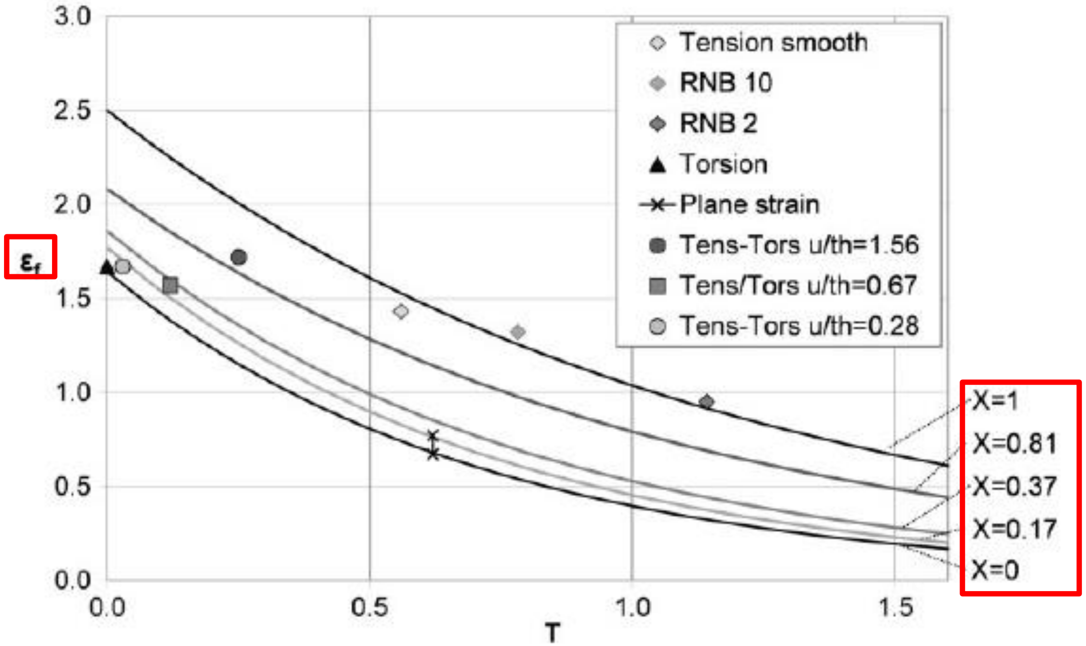
- ***Further Standardization Efforts to Develop Test Procedures for SE(T) and SE(B) Specimens***
- ***Crack Growth Estimation Issues in Toughness Testing Protocols for Shallow Crack SE(B)s***
- ***Robust J and CTOD Estimation Procedures for Surface Cracked Pipes***

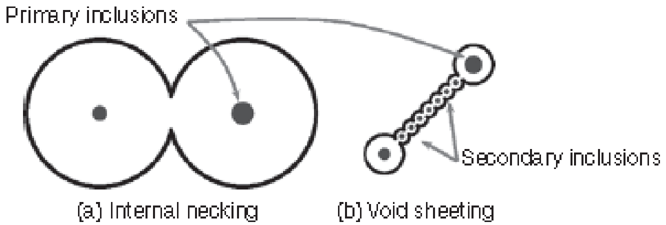
On-Going Work

- ***Lode Angle Dependence***

$$\Phi = \frac{\sigma_{eq}^2}{R^2} + 2q_1 \boxed{f_*} \cosh\left(\frac{1}{2} q_2 \frac{\sigma_{kk}}{R}\right) - 1 - q_1^2 \boxed{f_*^2}.$$

$$X = cos(3\theta) = \frac{27}{2} \frac{\boxed{J_3}}{\sigma_e^3} = \frac{3\sqrt{3}}{2} \frac{J_3}{\sqrt{J_2^3}}$$





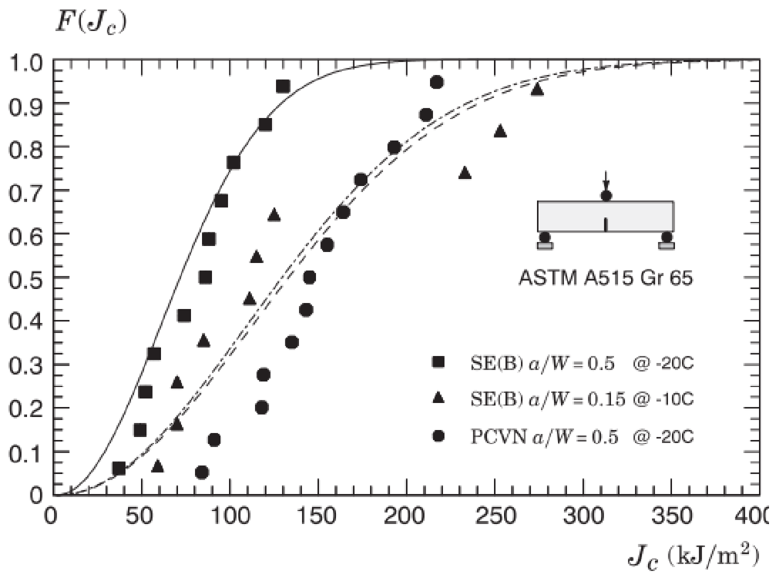
On-Going Work

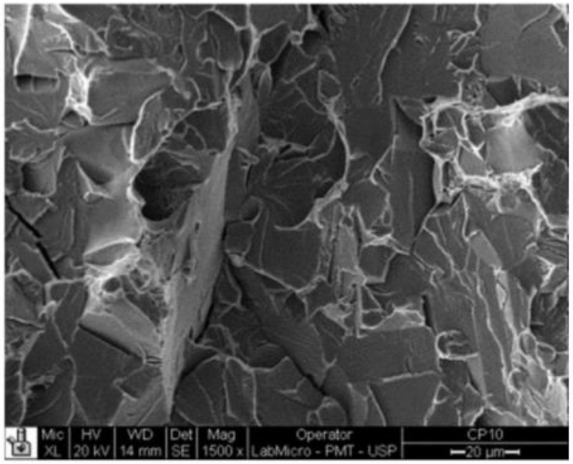
- ***Brittle Fracture***

On-Going Work

- *Micromechanical model based on Weibull Stress*
- *Probabilistic Models of Cleavage Fracture*
- *Transferability model for brittle fracture*
- *Calibration of Weibull Parameters*

$$\tilde{\sigma}_w = \left[\frac{1}{V_0} \int_{\Omega} \Psi_c(\epsilon_p) \cdot \sigma_1^m d\Omega \right]^{1/m}$$





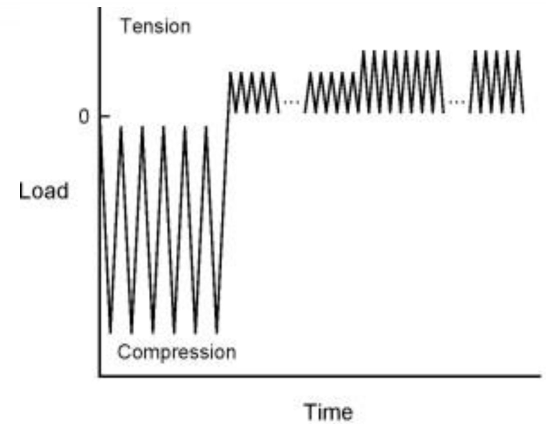
On-Going Work

- ***Fatigue***

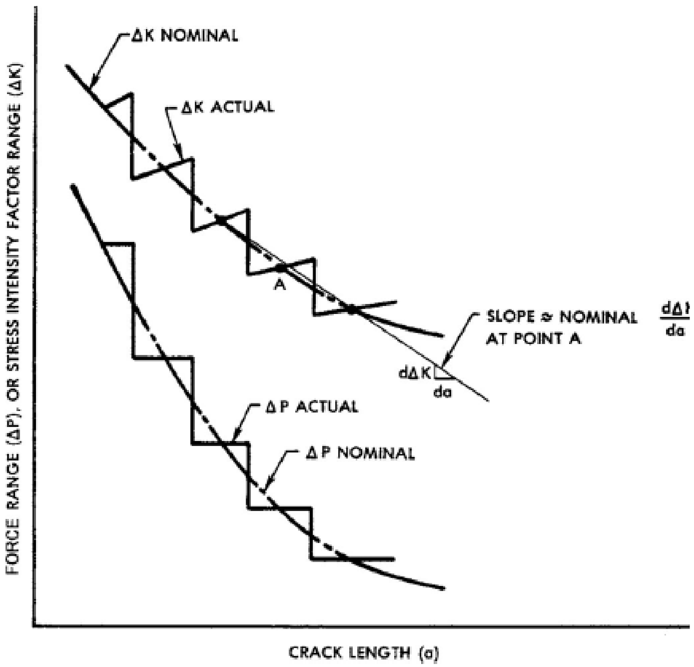
Threshold

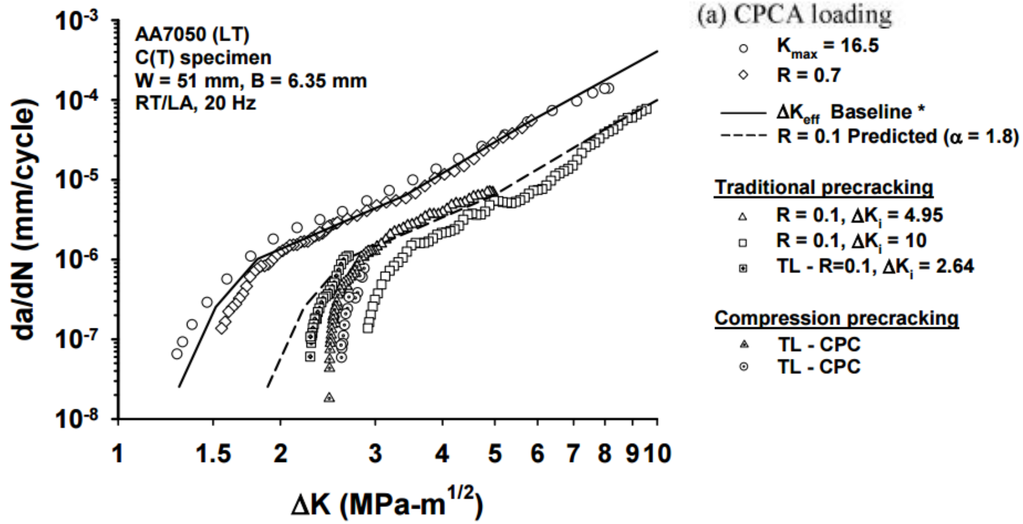
- Experimental Procedure ΔKth

CPC



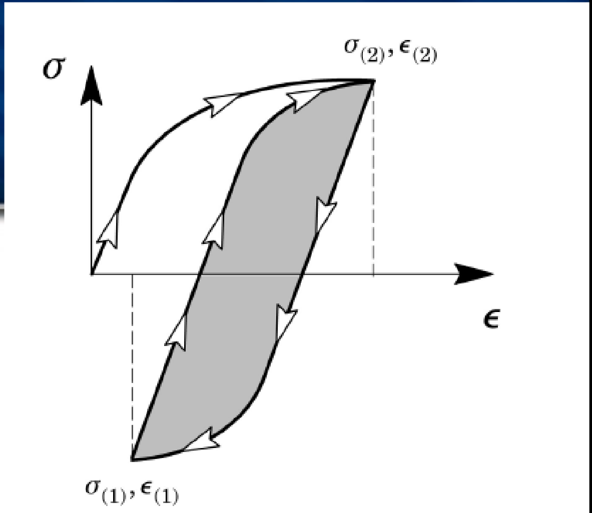
(a) CPCA loading





Small Cracks

- Methodology $$\frac{da}{dN} = C_J (\Delta J)^{m_J}$$



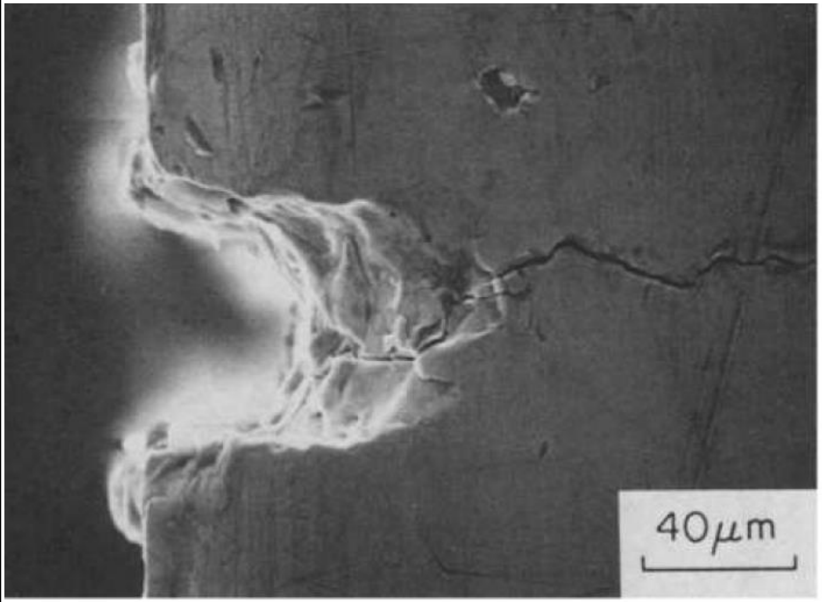
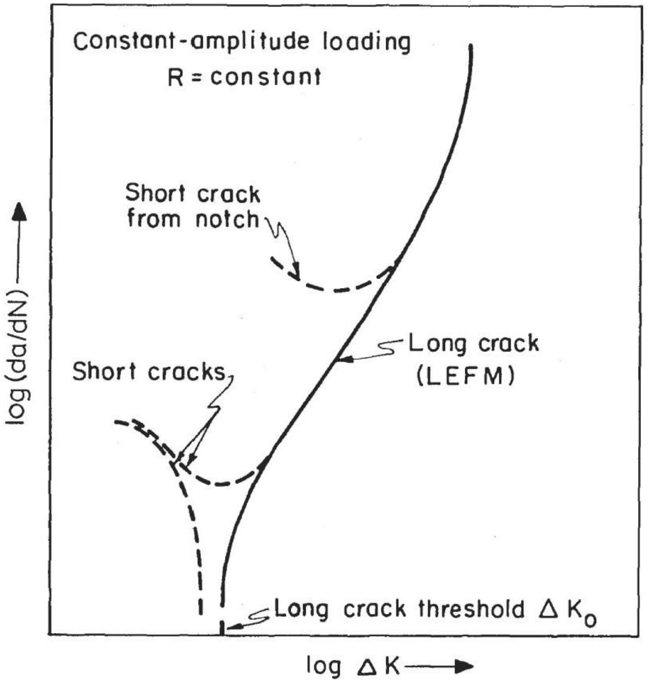
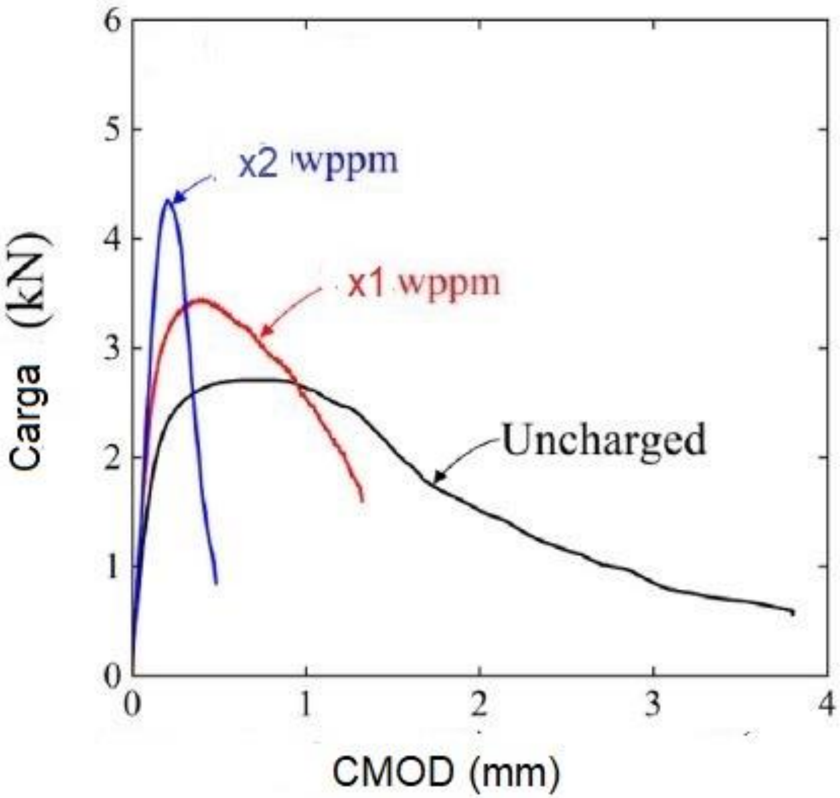


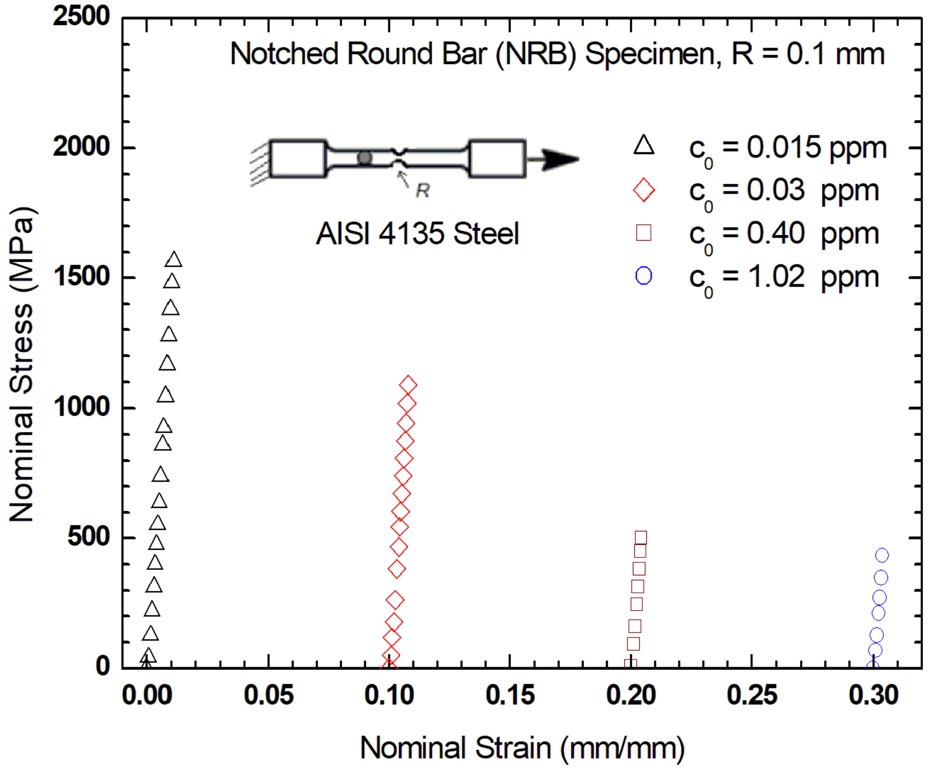
FIG. 2—*SEM micrograph of electro-discharge machined notch.*



Fragilização pelo Hidrogênio

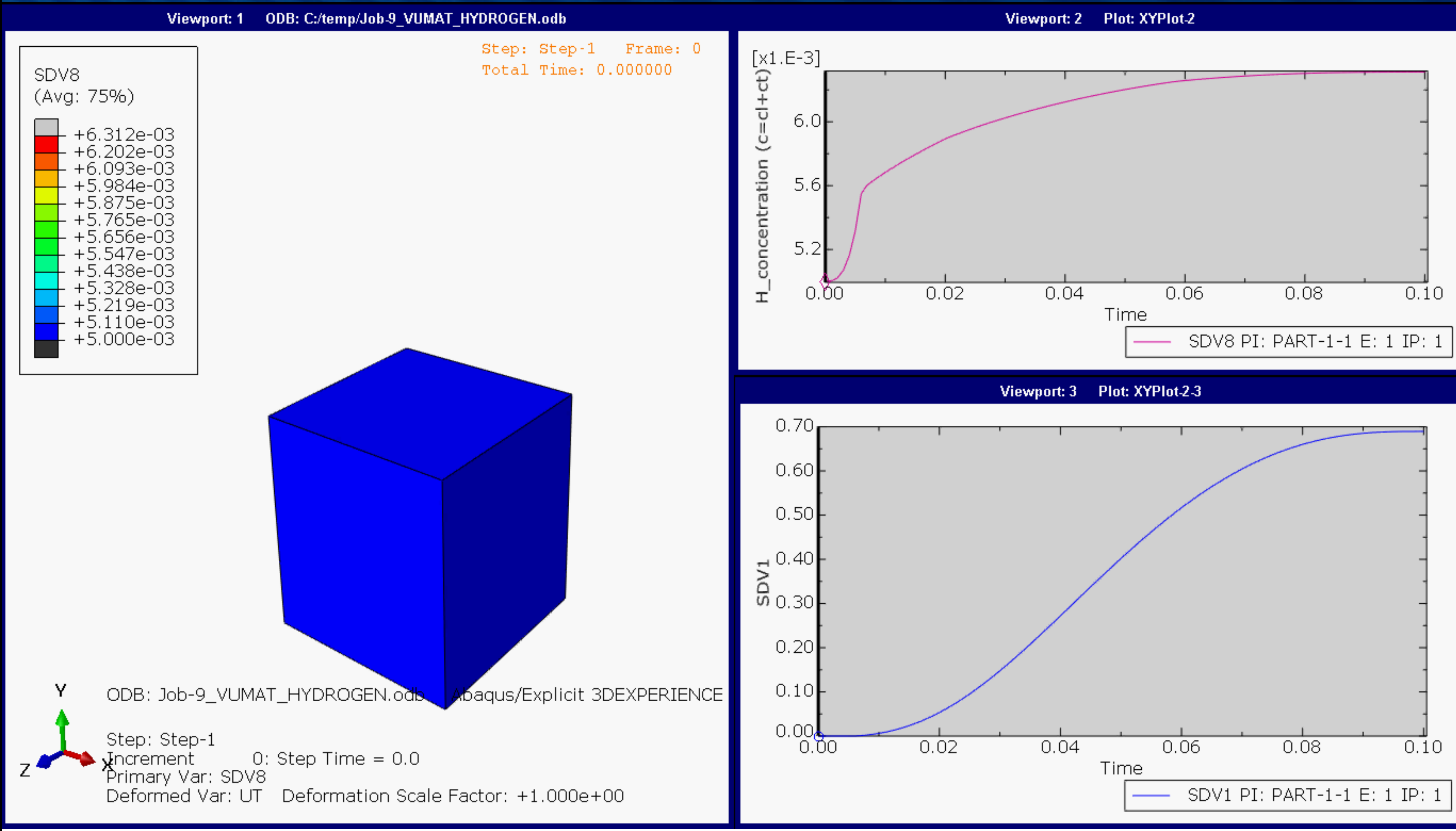


(a)

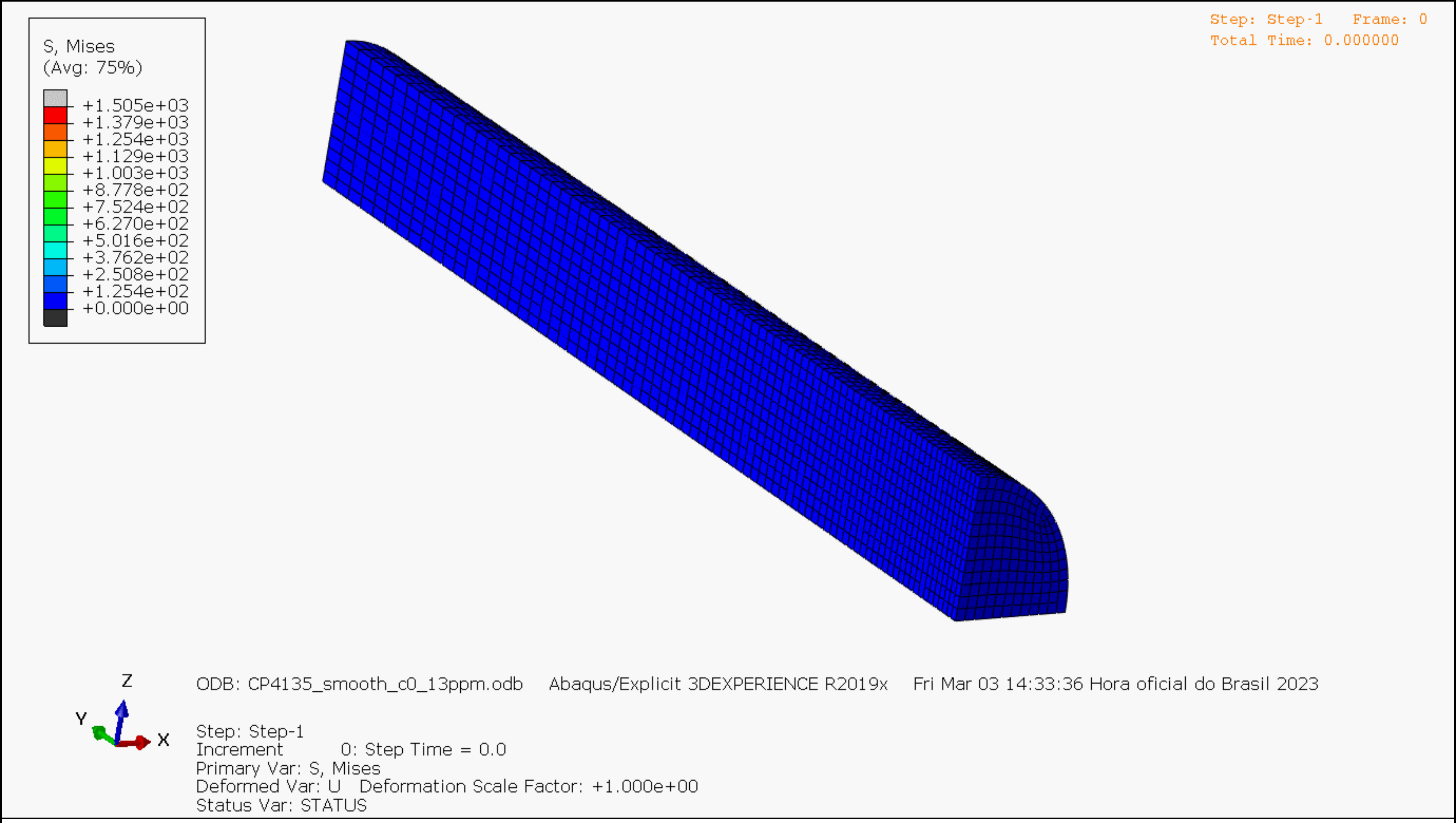


(a)

Fragilização pelo Hidrogênio



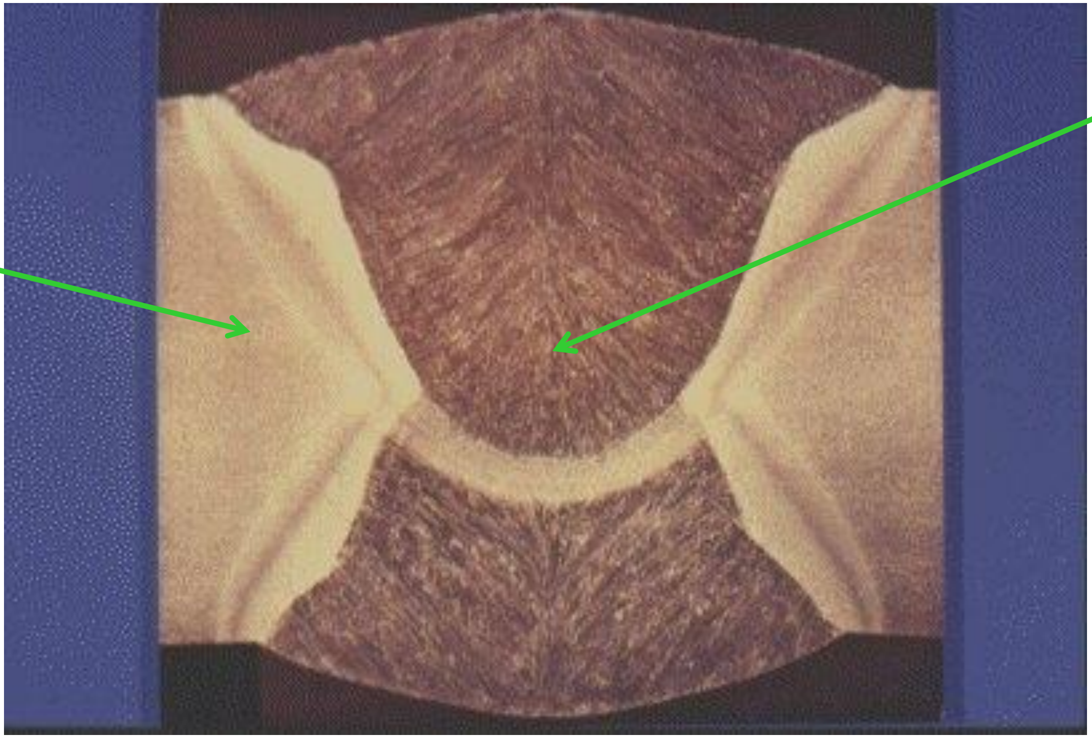
Fragilização pelo Hidrogênio



Mechanically Lined Pipes

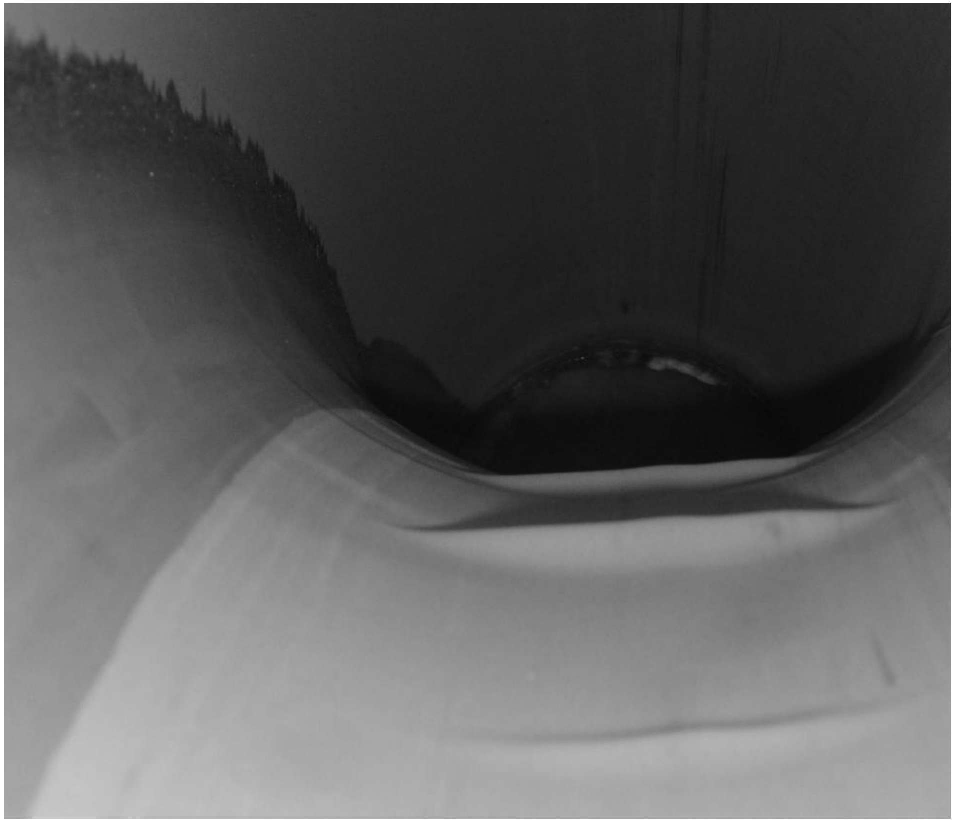
Lined pipes consist of a C-Mn pipe which has a layer of CRA in contact with the production fluid and hence, its corrosive environment. The layer of Corrosion Resistant Alloy (CRA) is applied through a mechanical bond between the CRA and the C-Mn pipe.

Key Issues



Fatigue and Fracture Behavior of Dissimilar Girth Welds Including H_2 Assisted Cracking

Key Issues



Wrinkle Formation

Key Applications of SE(T) Specimen

Riser Installation by Reeling

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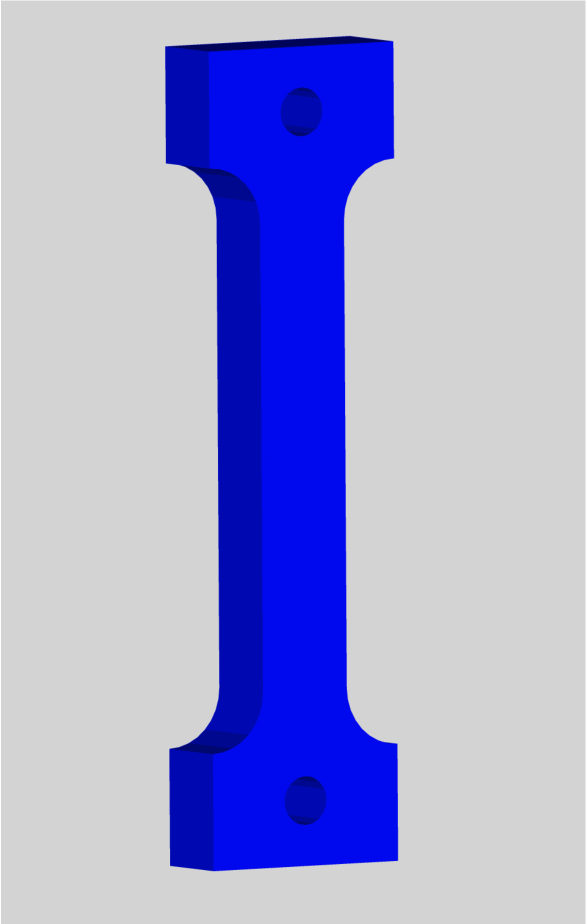
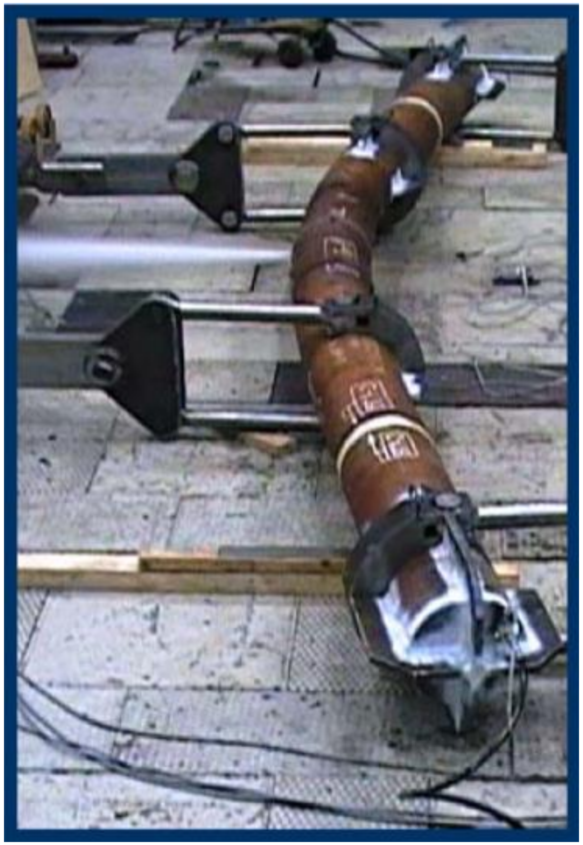
Key Applications of SE(T) Specimen

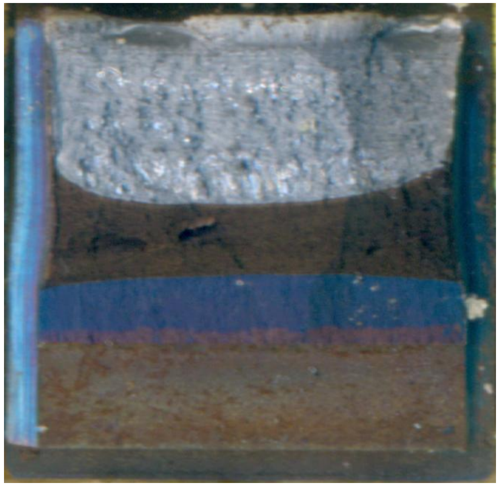
Riser Installation by Reeling

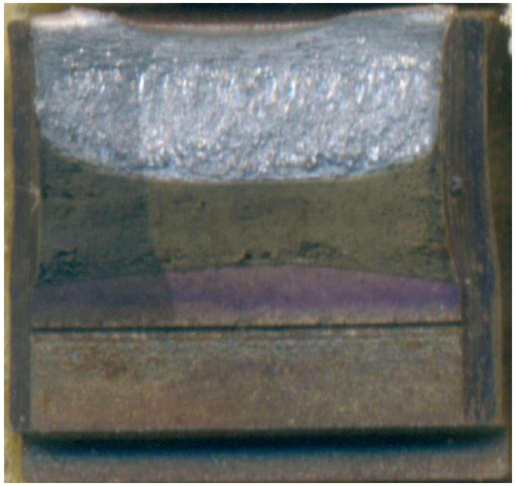
Mechanical Similitude of SE(T) Specimen



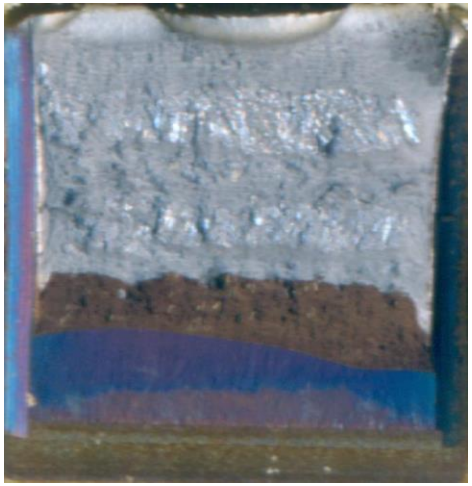


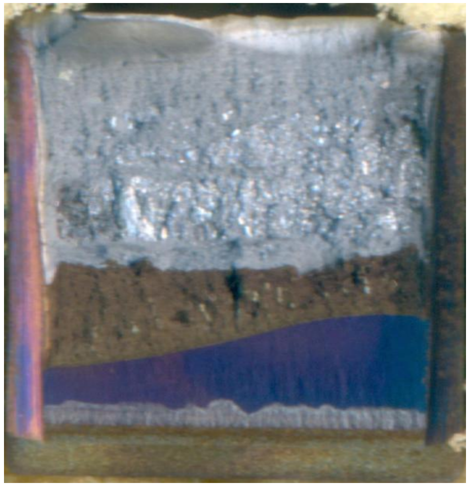
Crack Front Profiles: SE(T)





Crack Front Profiles: SE(B)





Thank You!

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