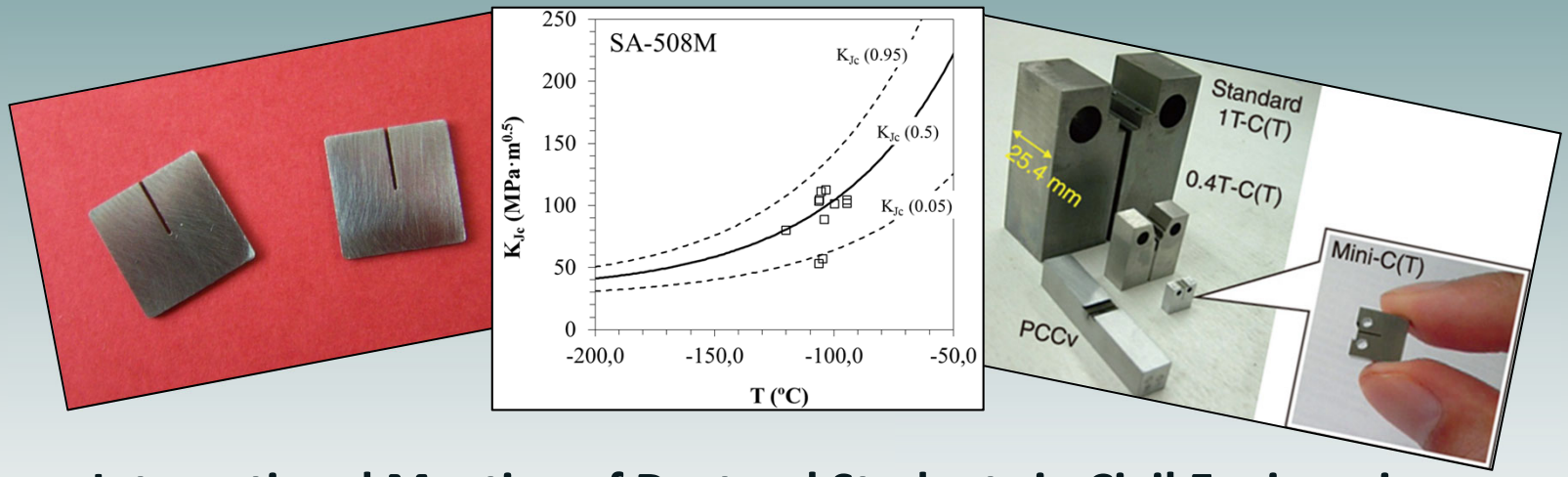
EVALUATION OF FRACTURE TOUGHNESS BY MEANS OF SUB-SIZE SPECIMENS



International Meeting of Doctoral Students in Civil Engineering

PhD Program in Civil Engineering

May 21st, 2021

PhD student: Marcos Sánchez Matías
Thesis directors: Sergio Cicero González
Borja Arroyo Martínez

FRACTESUS

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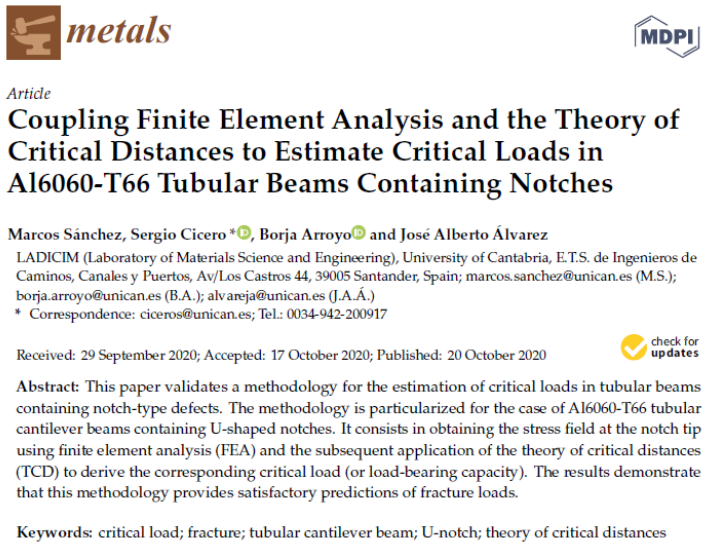
LABORATORIO DE LA DIVISIÓN DE CIENCIA E INGENIERÍA DE LOS MATERIALES

MOTIVATIONS

INTERNATIONAL MEETING OF DOCTORAL STUDENTS IN CIVIL ENGINEERING – EIDEIC 2021

BACKGROUND:

- ✓ Degree on mechanical engineering (2019)
  - Intern in LADICIM (2019) - project final degree
- ✓ Master's degree in integrity and durability of materials, components and structures (2020)
- ✓ Engineer in research projects in LADICIM - (2019-present)



metals

MDPI

Article

Coupling Finite Element Analysis and the Theory of Critical Distances to Estimate Critical Loads in Al6060-T66 Tubular Beams Containing Notches

Marcos Sánchez, Sergio Cicero *, Borja Arroyo and José Alberto Álvarez

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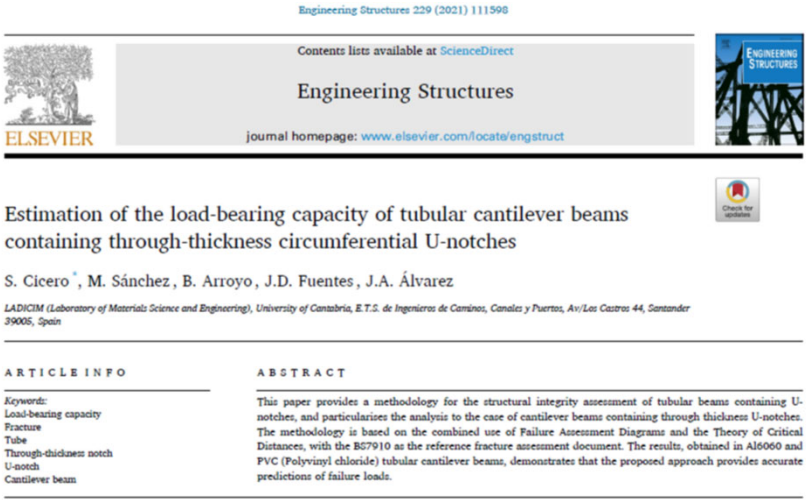
Received: 29 September 2020; Accepted: 17 October 2020; Published: 20 October 2020

check for updates

Abstract: This paper validates a methodology for the estimation of critical loads in tubular beams containing notch-type defects. The methodology is particularized for the case of Al6060-T66 tubular cantilever beams containing U-shaped notches. It consists in obtaining the stress field at the notch tip using finite element analysis (FEA) and the subsequent application of the theory of critical distances (TCD) to derive the corresponding critical load (or load-bearing capacity). The results demonstrate that this methodology provides satisfactory predictions of fracture loads.

Keywords: critical load; fracture; tubular cantilever beam; U-notch; theory of critical distances



Engineering Structures 229 (2021) 111598

Contents lists available at ScienceDirect

Engineering Structures

journal homepage: www.elsevier.com/locate/engstruct

ELSEVIER

Estimation of the load-bearing capacity of tubular cantilever beams containing through-thickness circumferential U-notches

S. Cicero *, M. Sánchez, B. Arroyo, J.D. Fuentes, J.A. Álvarez

LADICIM (Laboratory of Materials Science and Engineering), University of Cantabria, E.T.S. de Ingenieros de Caminos, Canales y Puertos, Av/Los Castros 44, Santander 39005, Spain

ARTICLE INFO

Keywords:
Load-bearing capacity
Fracture
Tube
Through-thickness notch
U-notch
Cantilever beam

ABSTRACT

This paper provides a methodology for the structural integrity assessment of tubular beams containing U-notches, and particularises the analysis to the case of cantilever beams containing through thickness U-notches. The methodology is based on the combined use of Failure Assessment Diagrams and the Theory of Critical Distances, with the BS7910 as the reference fracture assessment document. The results, obtained in Al6060 and PVC (Polyvinyl chloride) tubular cantilever beams, demonstrates that the proposed approach provides accurate predictions of failure loads.

FRACTESUS

MOTIVATIONS

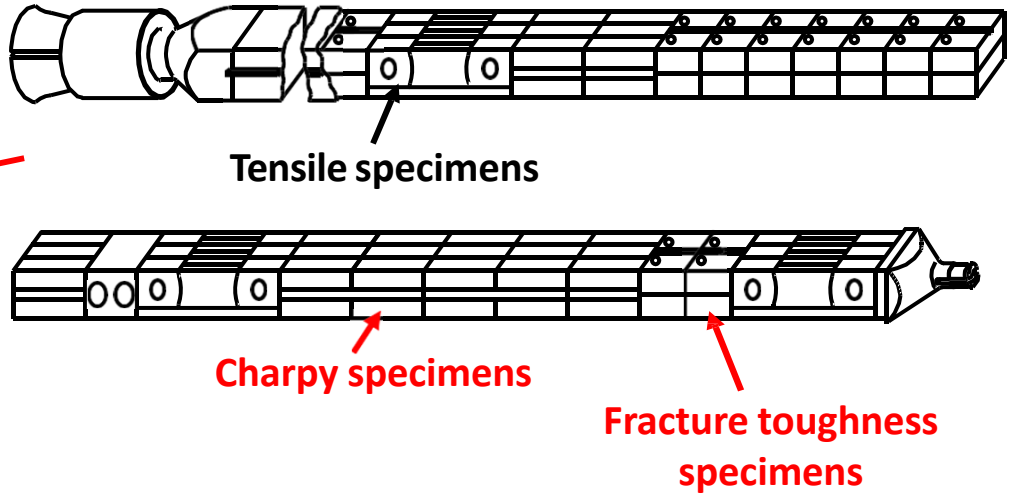
PERSONAL AND PROFFESIONAL DEVELOPMENT:

- ✓ CONTINUOUS TRAINING IN A PROFESSIONAL ENVIROMENT
- ✓ DEVELOP NEW SKILLS AND CAPABILITIES: CONSTANCE, PATIENTE, OVERCOMING SPIRIT
- ✓ OPPORTUNITY IN WORKING WITH GREAT EXPERTS IN A SPECIFIC AREAS- TEAMWORK
- ✓ NETWORKING
- ✓ MANAGE PROYECTS

RESEARCH CONTEXT

REACTOR PRESSURE VESSEL (RPV): SURVEILLANCE CAPSULE

Most of the nuclear power plants in operation in Europe are in the second half of their operational lives



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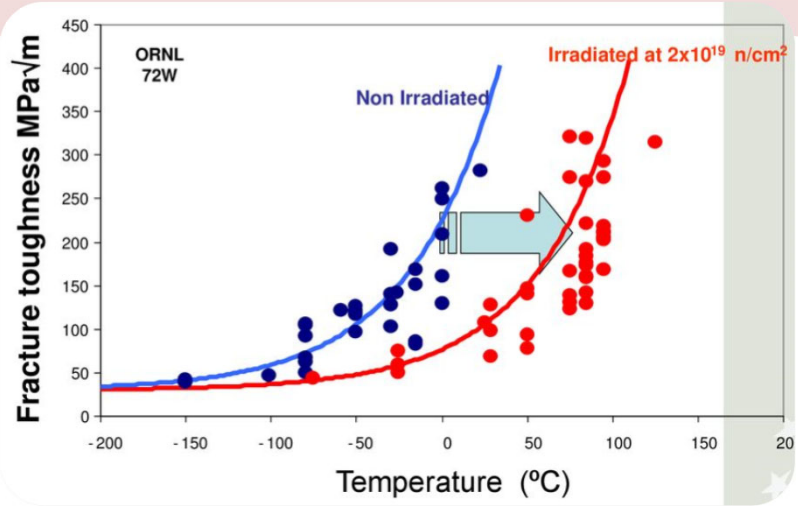
RESEARCH CONTEXT

REACTOR PRESSURE VESSEL (RPV): STRUCTURAL INTEGRITY

WHY SO IMPORTANT?

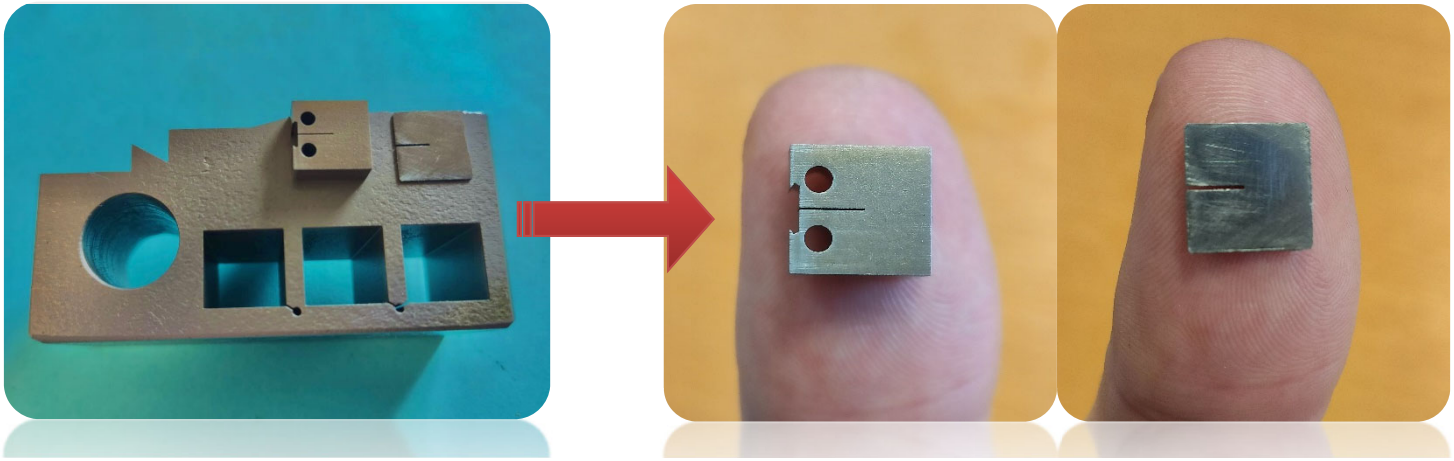
- ✓ Is the primary barrier against the release of radioactive material into the environment.
- ✓ Failure of RPV in normal and accident scenarios is excluded by design.
- ✓ It cannot be replaced.
- ✓ It suffers from hardening and toughness degradation as a result of thermal ageing and radiation exposure.



RESEARCH CONTEXT

ADVANTAGES OF USE SMALL SIZE SPECIMENS

- ✓ The (re)use and subsequent valorization of already tested specimens
- ✓ Smaller specimens provoke safer conditions to manage.
- ✓ Direct fracture toughness evaluation rather than a semi-empirical approach based on Charpy measurements.
- ✓ Significantly increasing the surveillance database, providing an increased confidence in the data.
- ✓ Characterization of local material properties in the case of material inhomogeneity.



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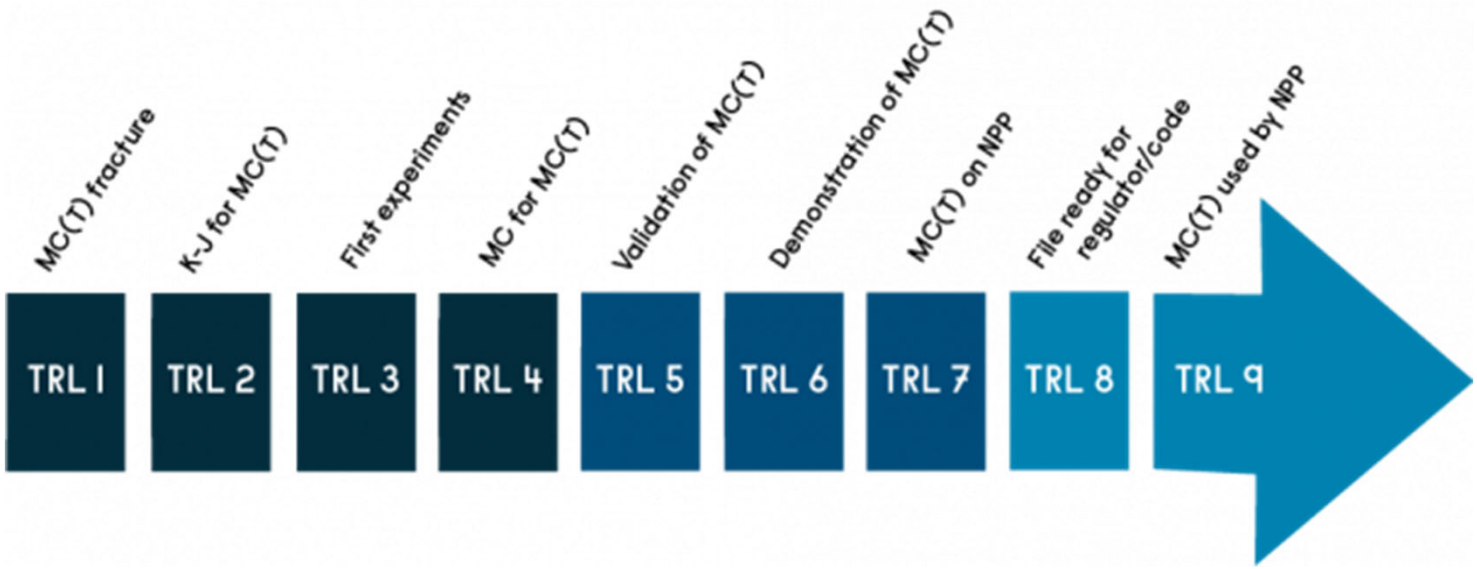
RESEARCH CONTEXT

INTERNATIONAL MEETING OF DOCTORAL STUDENTS IN CIVIL ENGINEERING – EIDEIC 2021

Starting date: 01/10/2020
End date: 30/09/2024

FRACTESUS



FRACTESUS

GOALS

MAIN GOAL:

- ✓ Demonstrate the reliability and the enhanced confidence of using small size specimens to measure the fracture resistance of structural materials.
- ✓ Application of the small size specimens in combination with the master curve approach for the characterization of the ductile to brittle transition region.

SECONDARY GOAL:

- ✓ Improve Small punch technique for fracture characterization.
- ✓ Comparison Small Punch vs Mini-CT specimens for fracture characterization.

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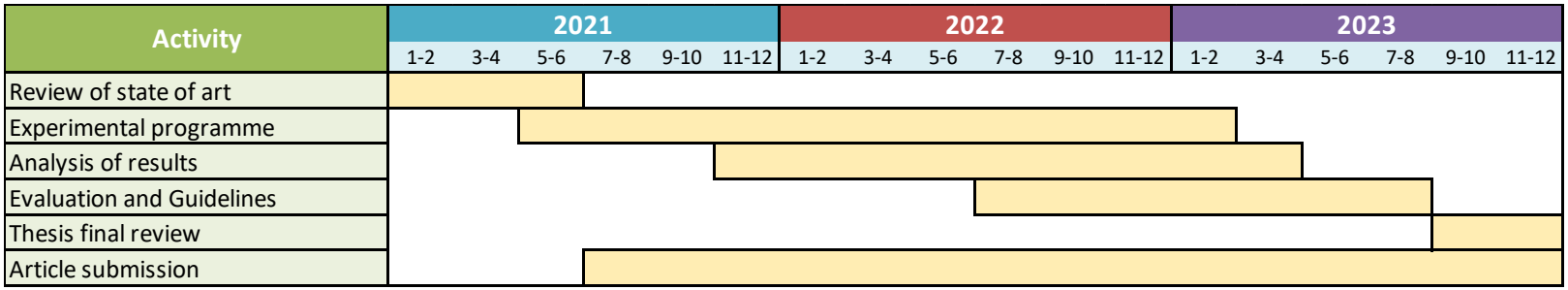
PLANIFICATION

INTERNATIONAL MEETING OF DOCTORAL STUDENTS IN CIVIL ENGINEERING – EIDEIC 2021



STATE OF ART:

- ✓ Review of previous theoretical aspects.
- ≈ Review of literature about mini-CT and small punch specimens for fracture characterization.

EXPERIMENTAL PROGRAM:

- ✓ Material selection.
- ≈ Design and manufacturing of all the tools required for testing.
- ≈ Specimen machining (Mini-CT and Small Punch).
- × Development of testing.
- × Results analysis.

ASSESSMENT OF THE MODEL:

- × Application of Master Curve approach thought Mini-CT and Small Punch results.
- × Validation of Master Curve.
- × Comparation of Mini-CT and Small Punch Master Curve.

FRACTESUS

Thank you for your time!

Marcos Sánchez Matías
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ANY QUESTIONS?