

EVALUATION OF FRACTURE TOUGHNESS BY MEANS OF SUBSIZE SPECIMENS

International Meeting of Doctoral Students in Civil Engineering EIDEIC23

May 19th, 2023

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1. Introduction

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Starting date: 01/10/2020 End date: 30/09/2024 EURATOM Work Programme 2019-2020 Grant Agreement nº 900014



1. Introduction







Advantages of small size specimens

- ✓ Valorization of previous tested specimens.
- Reduction of the volume of irradiated material.
- ✓ Direct fracture toughness evaluation.
- ✓ Multiplication of datapoints.
- Characterization of local material properties in the case of material inhomogeneity.



May 19th, 2023

2. Research status



MAIN OBJECTIVES

- 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.
- **•** Establish the foundations of mini-CT specimens for its inclusion in codes and standards.

Material	Туре	Туре	σ _{y (RT)} (MPa)	σ _{u (RT)} (MPa)	T ₀ (°C)	С	Si	Ρ	S	Cr	Mn	Ni	Cu	Мо	v	Nb	AI	Ti
ANP-5	Nuclear	WM	604	696	-38	0.08	0.15	0.015	0.013	0.740	1.14	1.110	0.220	0.60				
A533B LUS	Nuclear	BM	455	640	7.8	0.24	0.41	0.028	0.023	0.080	1.52	0.430	0.190	0.49				
S275JR	Structural	BM	328.4	518.5	-26	0.18	0.26	0.012	0.009	0.018	1.18	0.085	0.060	0.12	0.020		0.034	0.022
S355J2	Structural	BM	376.4	557.6	-133	0.20	0.32	0.012	0.008	0.050	1.39	0.090	0.060	0.12	0.020		0.014	0.022
S460M	Structural	BM	473	595	-91.8	0.12	0.45	0.012	0.001	0.062	1.49	0.016	0.011		0.066	0.036	0.048	0.003
S690Q	Structural	BM	775	832	-89.8	0.15	0.40	0.006	0.001	0.020	1.42	0.160	0.010		0.058	0.029	0.056	0.003

MATERIAL MATRIX

2. Research status







Material	Τ ₀ (°C)	σΤ ₀ (°C)	r	Ν	$\sum \mathbf{r_i} \cdot \mathbf{n_i}$	Homogeneity screening	T _{0 mini-CT} - T _{0 large}
ANP-5	-26.1	6.7	14	16	1.8	Inhomogeneous	11.90
A533B LUS	7.2	6.6	13	14	1.63	Homogeneous	-4.40
S275JR	-64.4	8.15	8	16	1	Inhomogeneous	-38.40
S355J2	-105.5	6.86	13	16	1.7	Homogeneous	27.46
S460M	-122.6	6.57	13	19	1.85	Homogeneous	-30.84
S690Q	-89.8	8.15	7	8	1.03	Homogeneous	20.95

3. Competencies



BASIC SKILLS

CB11 Systematic understanding of a field of study and command of the skills and research methods related to the field \rightarrow Fracture mechanics on structural materials.

CB12 Skill to conceive, design or create, implement and adopt a substantial process of research or creation \rightarrow **Development of a new experimental set-up.**

CB13 Skill to contribute to the enlargement of the knowledge limits through an original research \rightarrow **PhD dissertation, publications.**

CB14 Skill to carry out a critical analysis and assessment and synthesis of new and complex ideas \rightarrow **Daily work.**

CB15 Skill to communicate with the academic and scientific community and with society in general about the scope of knowledge in the ways and languages of common use in the international scientific community \rightarrow Publications, conferences (national and international), common social network.

CB16 Skill to encourage, in academic and professional contexts, the scientific, technological, social, artistic or cultural progress in a society based on knowledge \rightarrow **publications, conferences.**



CAPACITIES AND PERSONAL ABILITIES

CA01 Cope in contexts in which there is little specific information \rightarrow Literature review, courses, self-learning.

CA02 Find the key questions to be answered to solve a complex problem \rightarrow **Publications.**

CA03 Design, create, develop and undertake new and innovative projects in the knowledge scope \rightarrow Fractesus project, favorable annual evaluations.

CA04 Work both in teams and individually in an international or multidisciplinary context

 \rightarrow Fractesus project, international mobility (soon).

CA05 Integrate knowledges, face complexity and formulate judgements with limited information \rightarrow Literature review.

CA06 Intellectual criticism and defense of solutions \rightarrow SWOT analysis.

4. Academic status



• Multidisciplinary Training

Basic Skills40 hAdvance Skills22 h

• International mobility (CA04)

October 2023



ZDR

Communications

- ✓ European Conference on Fracture 2022
- \checkmark 26th International Conference on Fracture and Structural Integrity
- ✓ 5th Iberian conference on structural integrity
- ✓ 2nd International Symposium on Notch Mechanics
- ✓ 27th International Conference on Fracture and Structural Integrity
- \checkmark 39th Meeting of the Spanish Society of Structural Integrity
- $\checkmark\,$ VII International meeting of doctoral students in civil engineering
- \checkmark IX International meeting of doctoral students in civil engineering

 Annual Evaluations (CB11-CB14-CA01-CA03-CA06)

Year 1	Favourable
Year 2	Favourable
Year 3	In progress

- Publications (CB12-CB13-CB15-CB16-CA02)
- ✓ On the use of mini-CT specimens to define the Master Curve of unirradiated Reactor Pressure Vessel steels with relatively high reference temperatures
- ✓ Using Mini-CT Specimens for the Fracture Characterization of Ferritic Steels within the Ductile to Brittle Transition Range: A Review

	Theoretical and Applied Fourture Mechanics 124 (2023) 103736		set metals	MDPI
ELSEVIER	committies available at Sciencement Theoretical and Applied Fracture Mechanics journal homepage www.elsevier.com/scienchames		Reader Using Mini-CT Speciment Ferritic Steels within the I A Review	s for the Fracture Characterization of Ductile to Brittle Transition Range:
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5. SWOT Analysis



 Strengths Equipment & facilities Great teamwork & support EU project funding 	WeaknessesMiniaturization is a challenge itself
 Opportunities International networking International mobility Conferences, seminars 	ThreatsComparison with old results







Thank you for your attention!

Any question?



