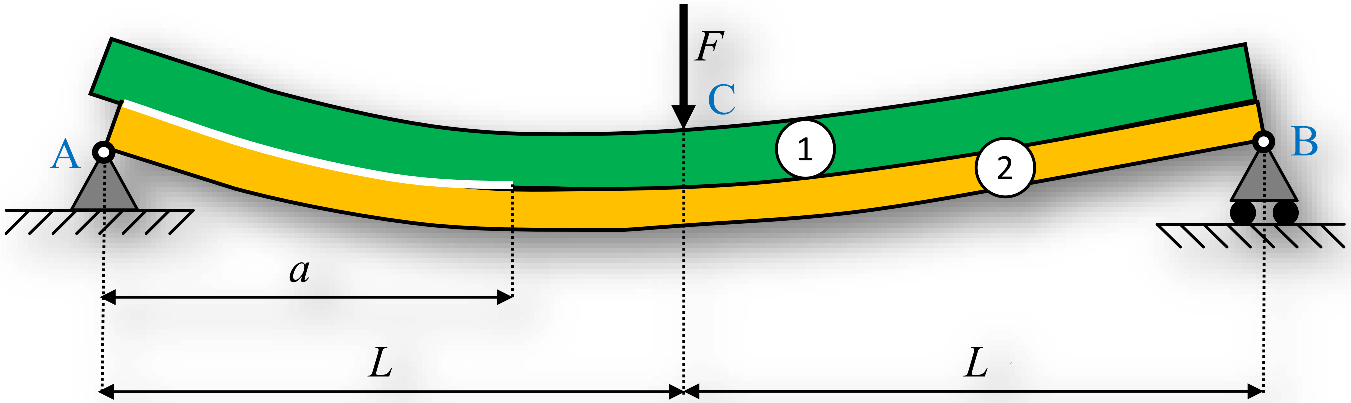

Fracture Characterization of bimaterial joints in pure mode II

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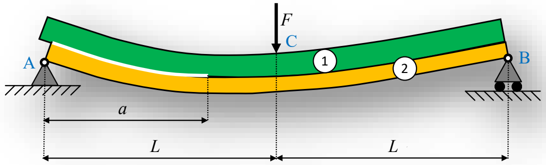
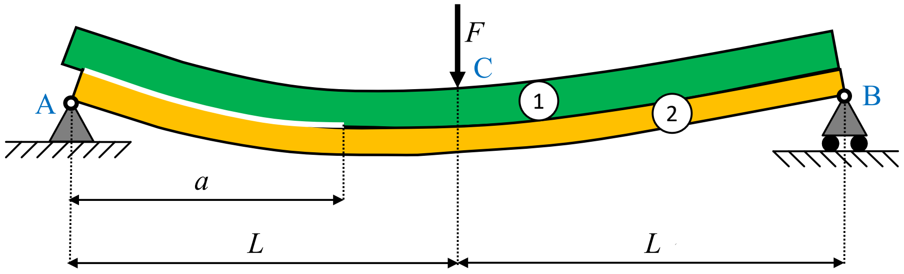
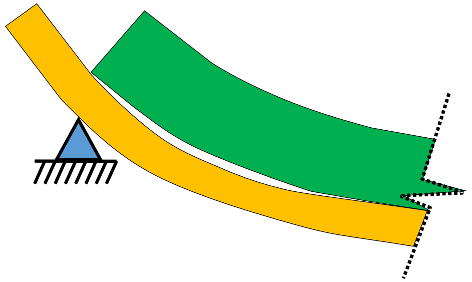
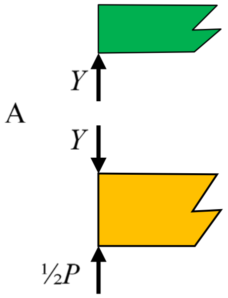




Upper arm being stiffer





$$Y = \tfrac{1}{2} F \frac{a^2 d_2 + 3 s_2}{a^2 (d_1 + d_2) + 3(s_1 + s_2)}$$

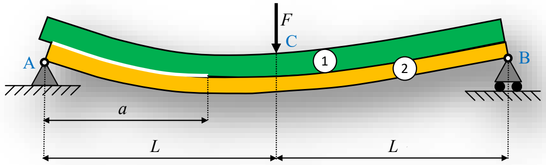
$$Y \approx Y_f = \tfrac{1}{2} F \frac{d_2}{d_1 + d_2}$$

d_i, s_i: bending and shear compliances, respectively

Pure mode II: Null distribution of normal stresses in the non-cracked zone

$$Y = V_1 \quad \Rightarrow \quad \frac{h_1}{h_2} = \sqrt{\frac{E_2}{E_1}}$$

Mode decoupling in interlaminar fracture thoughness tests on bimaterial specimens, *Engineering Fracture Mechanics*, (2023), https://doi.org/10.1016/j.engfracmech.2023.109454



Determination of the ERR in pure mode II

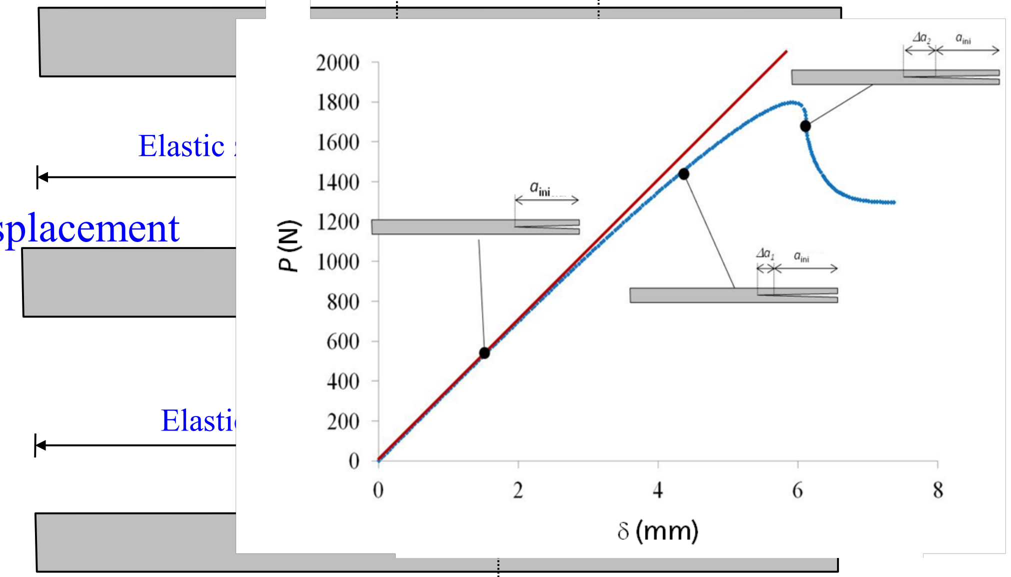
In pure mode II, in the non-cracked part the section rotation is the same in both arms.

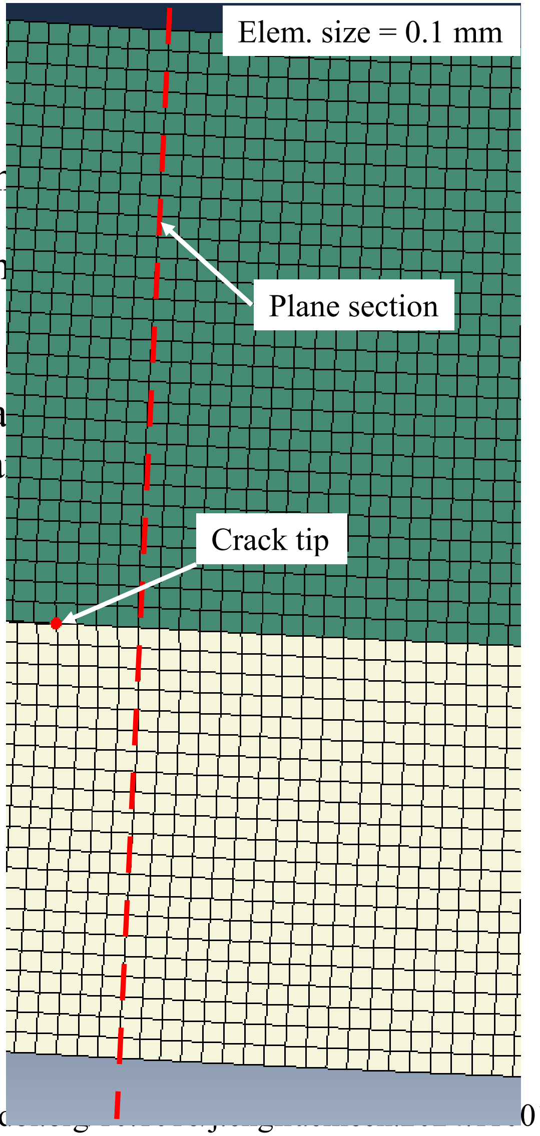
The energy release rate(ERR) is determined based on the strain complementary energy or coe

Knowing the compliance and the elastic properties, the **equivalent crack length** can be deter effects that affect the compliance, including the fracture process zone (FPZ).

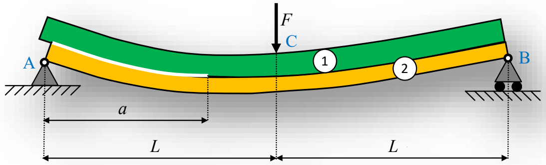
The energy release rate is analytically determined as a funcion of the equivalent crack length a
The results are the same as those obtained by the J-integral in terms of rotated angles in load a

Experimental data: load and displacement





Energy release rate in bimaterial specimens tested in pure modes I and II, *Engineering Fracture Mechanics*, (2024), https://d...012



LEFM: Numerical and analytical results

$F = 500$ N, $2L = 100$ mm

FEM

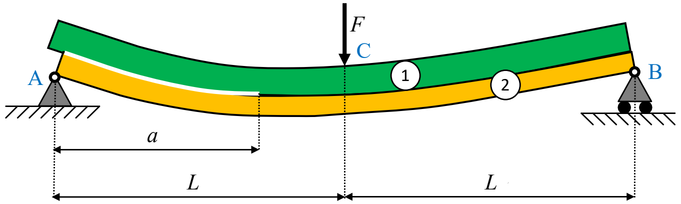
Global method

$$G_{II} = \frac{F_C}{2w\Delta a}\left[\delta_C(a+\Delta a) - \delta_C(a)\right]$$

VCCT: at the crack tip

$$G_{II} = \frac{F_t(a)}{2w\Delta a}\left[\delta_{rt}(a-\Delta a)\right]$$

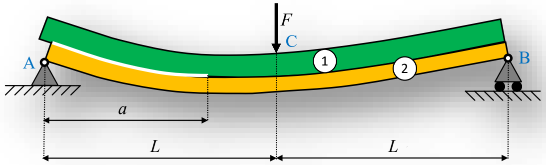
$$\frac{h_1}{h_2} = \sqrt{\frac{E_2}{E_1}}$$



VCCT and global method: differences up to 2%

Configuration	VCCT (FEM)				Approach	Global FEM	Difference (%)
	G_I(N/m)	G_{II}(N/m)	G_{I+II}(N/m)	G_{II}/G	(N/mm)	(N/mm)	
Aluminum–AS4/8552	8.4	695.5	703.9	98.8%	679	700	-3.0%
Aluminum–steel	11.8	579.4	591.2	98.0%	568	580	-2.1%
AS4/8552, [90º//0º]	2.6	2673	2676	99.9%	2671	2625	1.8%

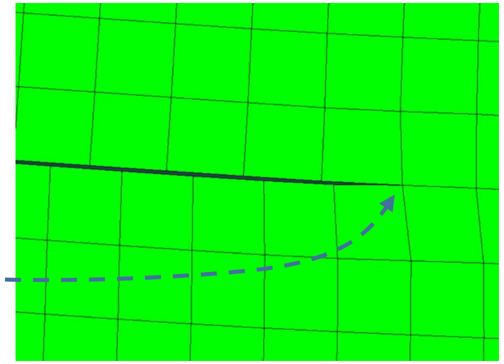
Energy release rate in bimaterial specimens tested in pure modes I and II, *Engineering Fracture Mechanics*, (2024), https://doi.org/10.1016/j.engfracmech.2024.110012



The relevance of the equivalent crack length

Aluminium-AS4/8552, FM-300 adhesive, cohesive elements

Visual crack length: the last linked node



The FPZ is advancing…

Equivalent crack length: compliance and elastic properties

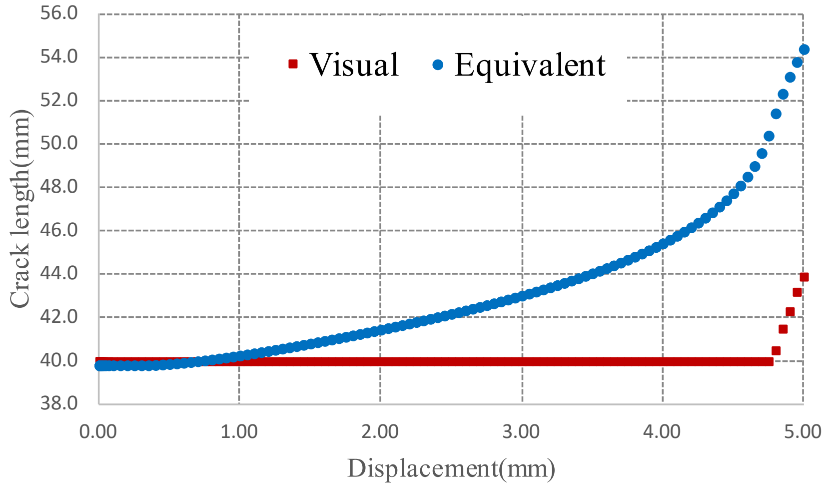
ERR(FEM): J_{II} by the integration of the traction-separation law

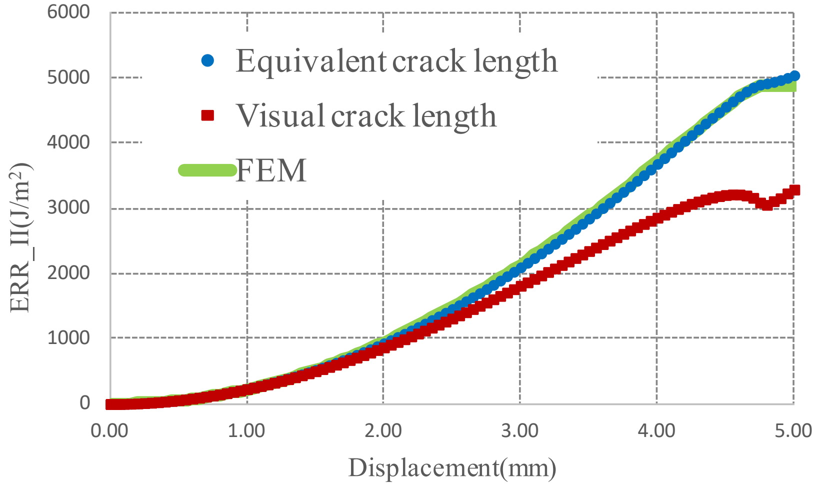
ERR(approach): analtyical approach developed for G_{II}

Visual crack length

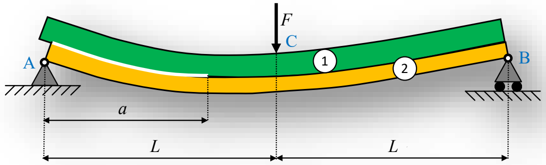
Equivalent crack length

Agreement when the equivalent crack length is used





On the relevance of the equivalent crack length in the determination of the ERR in modes I and II, *Engineering Fracture Mechanics*, (2025), https://doi.org/10.1016/j.engfracmech.2025.111224.

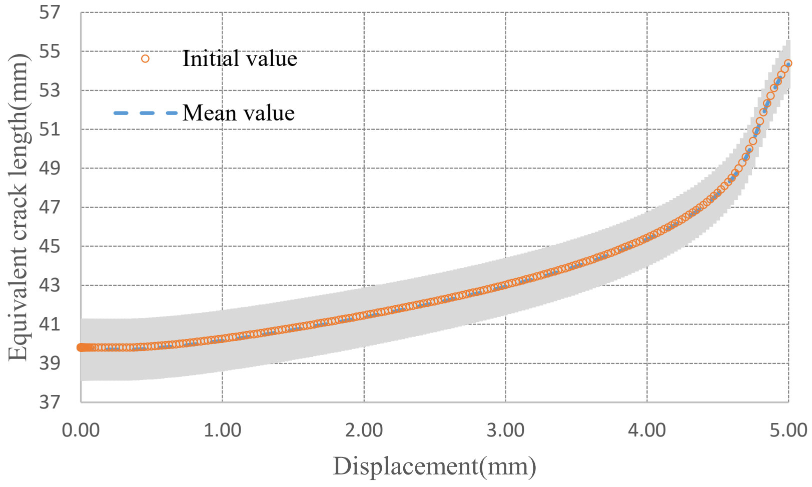


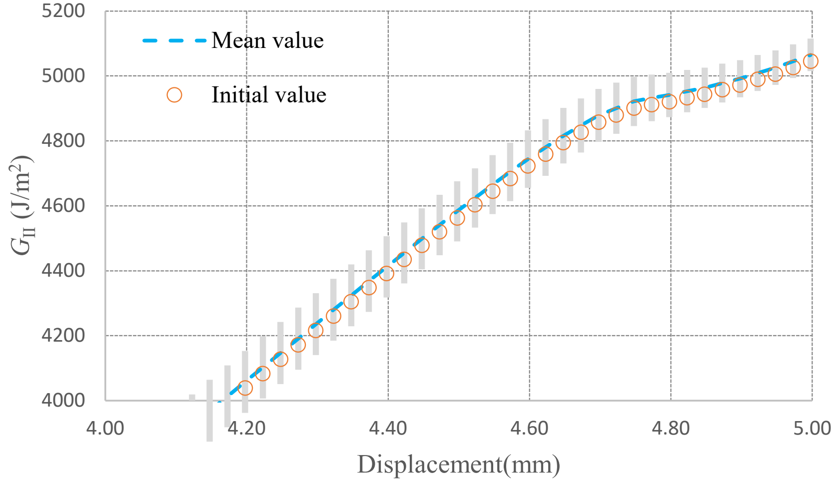
UPV EHU

Aluminium-AS4/8552, FM-300 adhesive, cohesive elements

	h, h_1 (mm)	w, L (mm)	E_1, E_2 (%)	G_1, G_2 (%)
Uncertainty	±0.005	±0.05	±5	±10

Monte Carlo simulation: 10^4 iterations





Maximum SD of G_{II}

	a_{eq} (mm)	G_{II} (J/m^2)
Initial	46.4	4128
10^4 iterations		
Mean	46.3	4147
SD	1.36	94.4
CV (%)	2.9	2.3

Assuming accurate values of a

	a (mm)	G_{II} (J/m^2)
Initial	54.4	5045
10^4 iterations		
Mean	54.4	5081
SD	0	182
CV (%)	0	3.6

Assuming accurate values of a, the CV of G_{II} is greater than when a values have uncertainties

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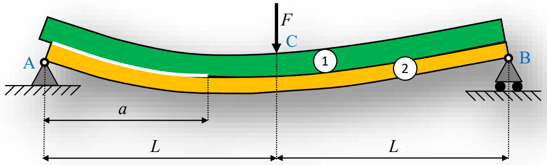

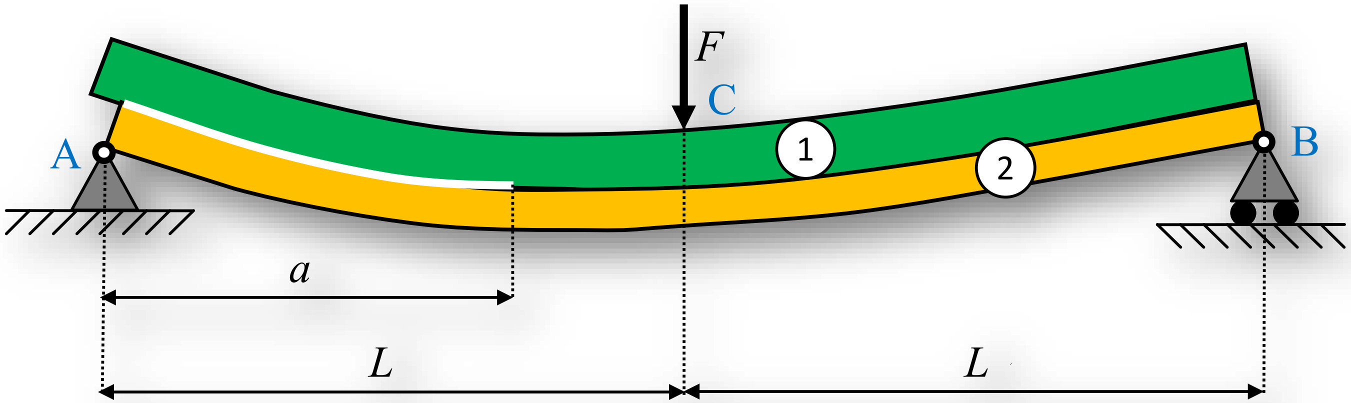

Fracture Characterization of bimaterial joints in pure mode II

MANY THANKS