Effect of Coarse Aggregates on FRP Strain Distribution in a FRP-to-Concrete Bonded Joint

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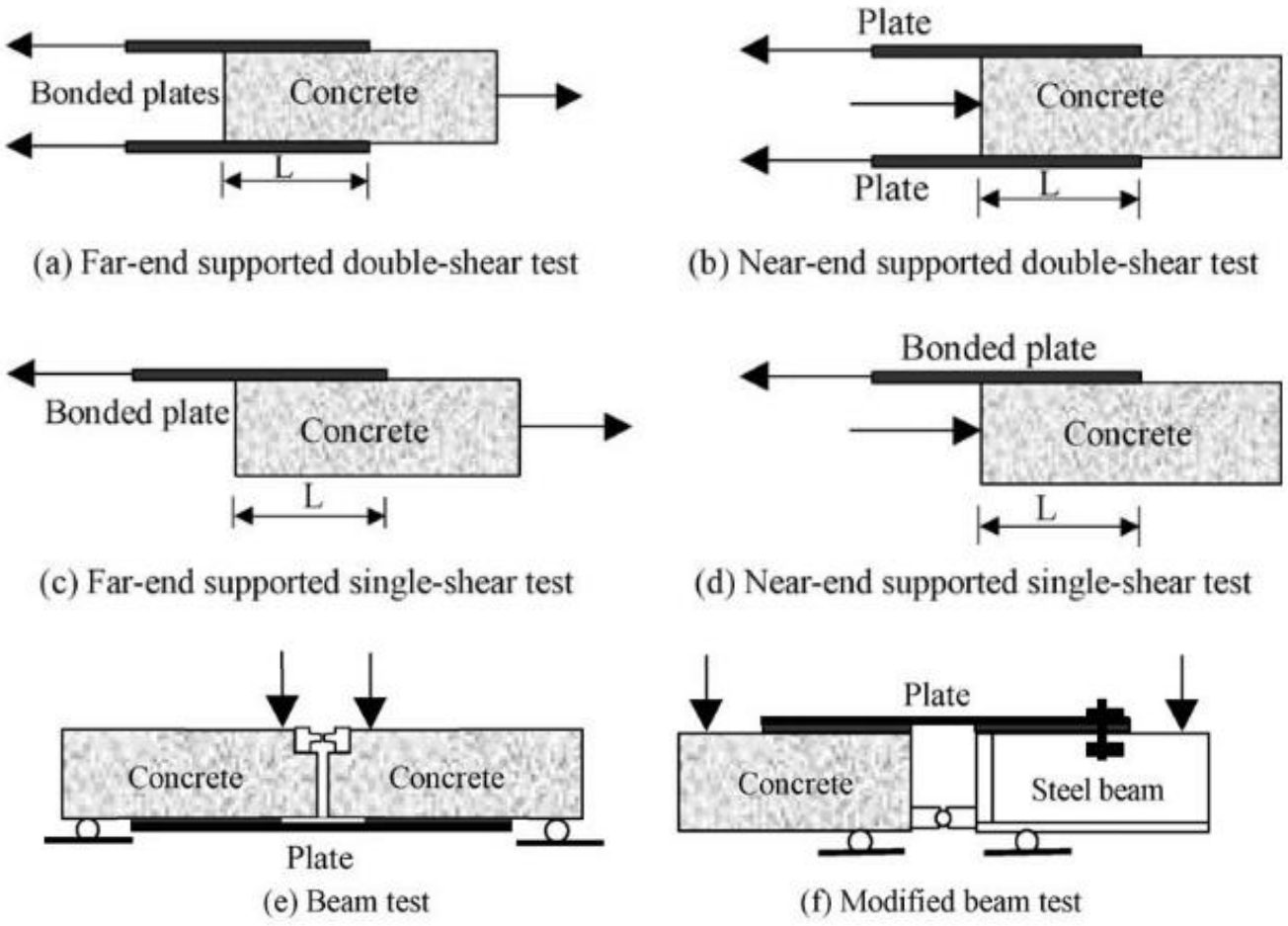
Introduction



FRP bond test Chen et al. (2001)

J.L. Pan (2010)

Typical failure mode

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- Conclusions

Theoretical bond strength models

- Parameters

  f_c', b_c;

  E_p, t_p, b_p, L_p;

  . . .

- Effective bond length

- Models

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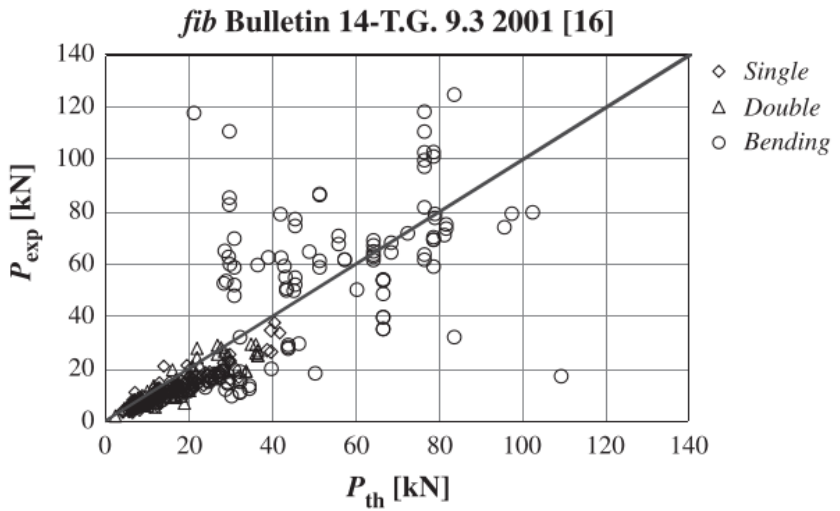

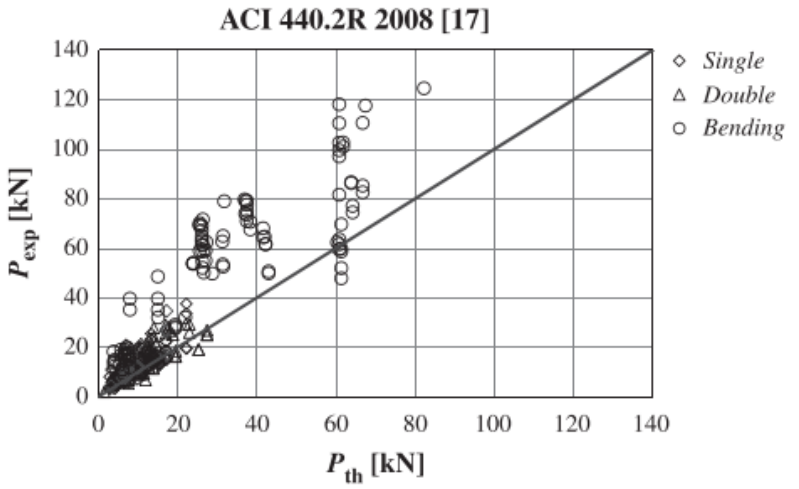

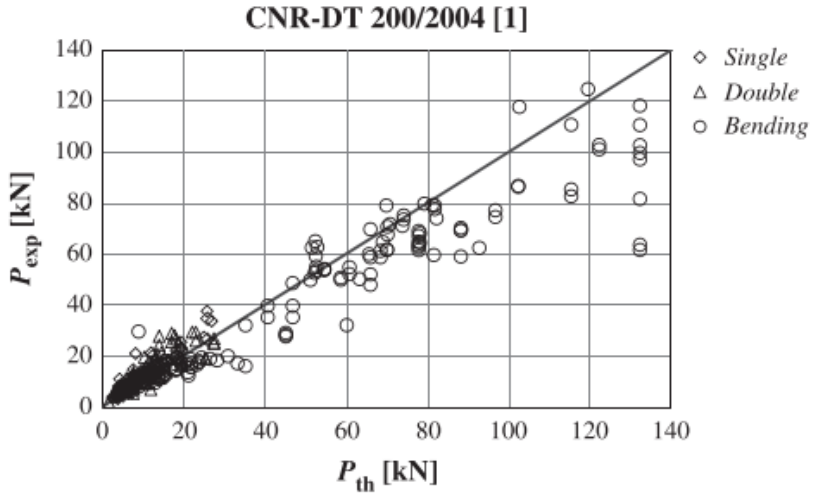

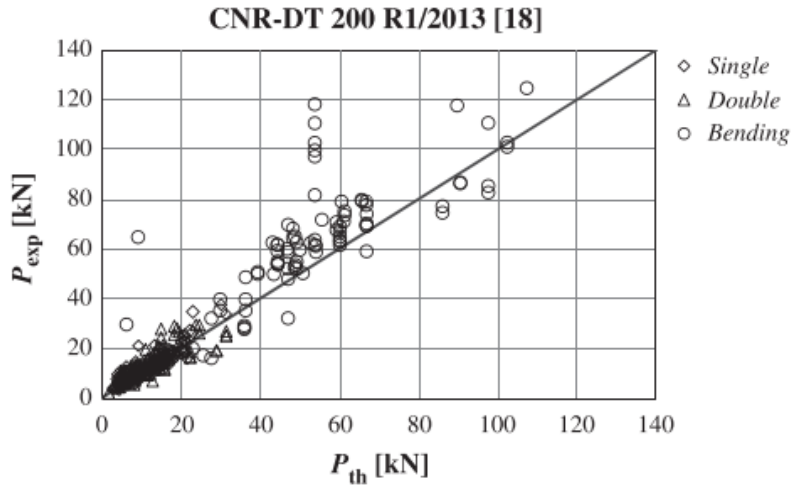

(D'Antino, T. and Pellegrino, C., 2014)

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Numerical FE models

Modelling of

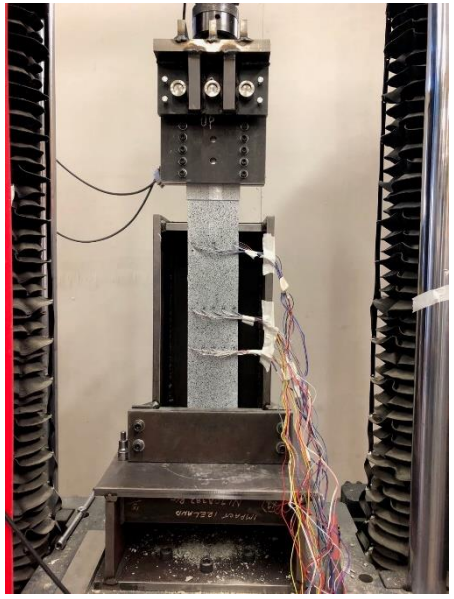
FRP-to-concrete interface

Use interface element based on a bond-slip model

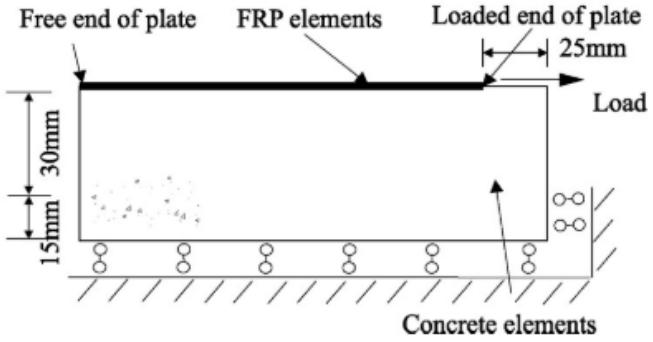
← Regression analysis of test data

↑ Directly model the bond behavior of the FRP-to-concrete joint at a mesoscale level

Use very small element size (~1mm)

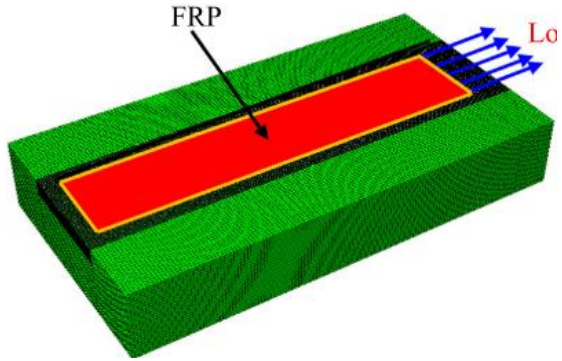


Single shear pull-off test



2D plane stress model

Lu et al. (2005)



3D FE model

Lin et al. (2017)

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Numerical FE models

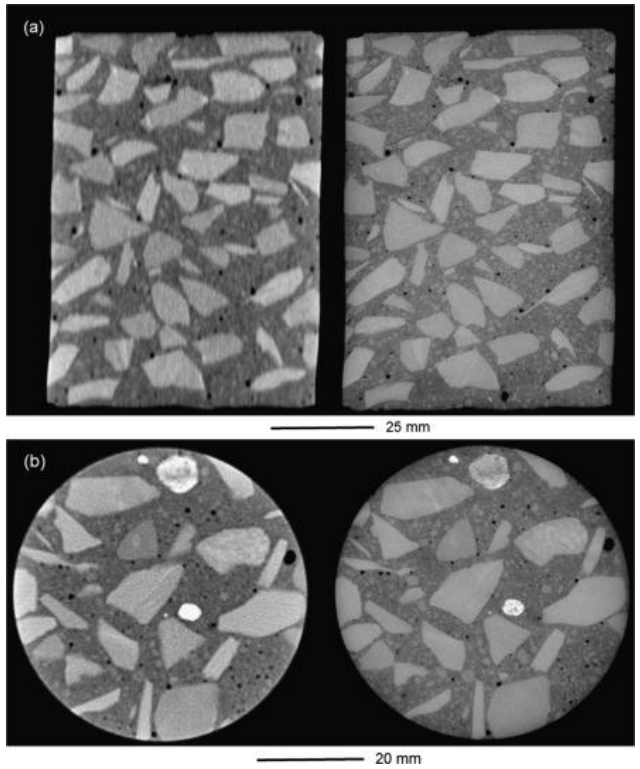
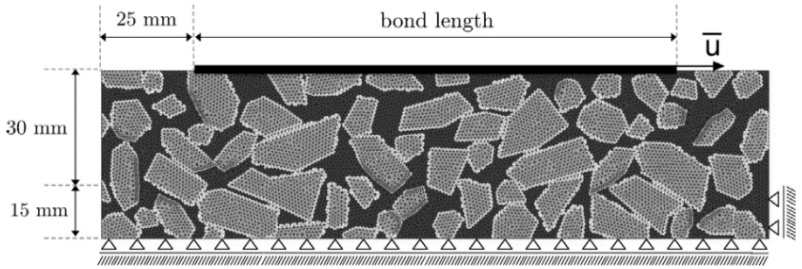
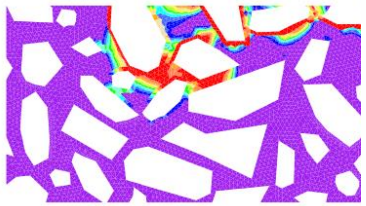
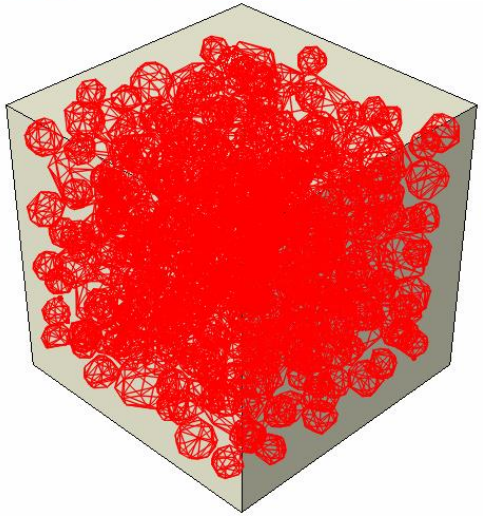


Photo of a concrete sample

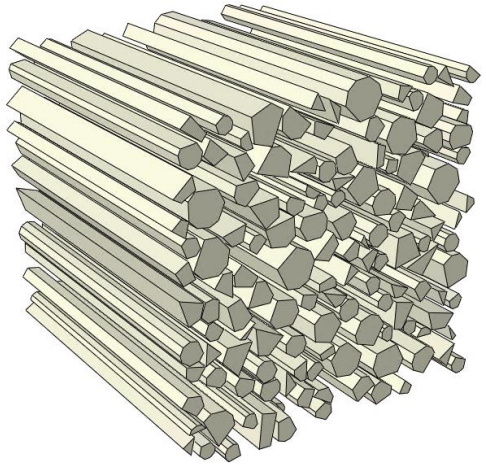


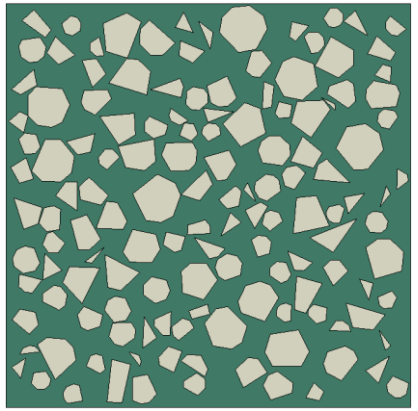


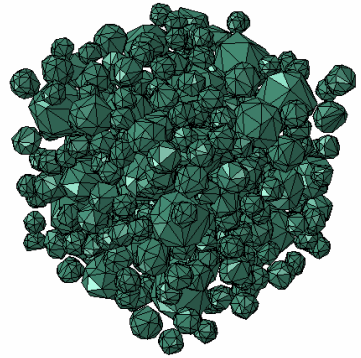


2D mesoscopic model of an FRP-to-concrete bonded joint

(Credited by Palmieri and De Lorenzis, 2014)







2D mesoscopic concrete sample

2D plane stress/strain assumption

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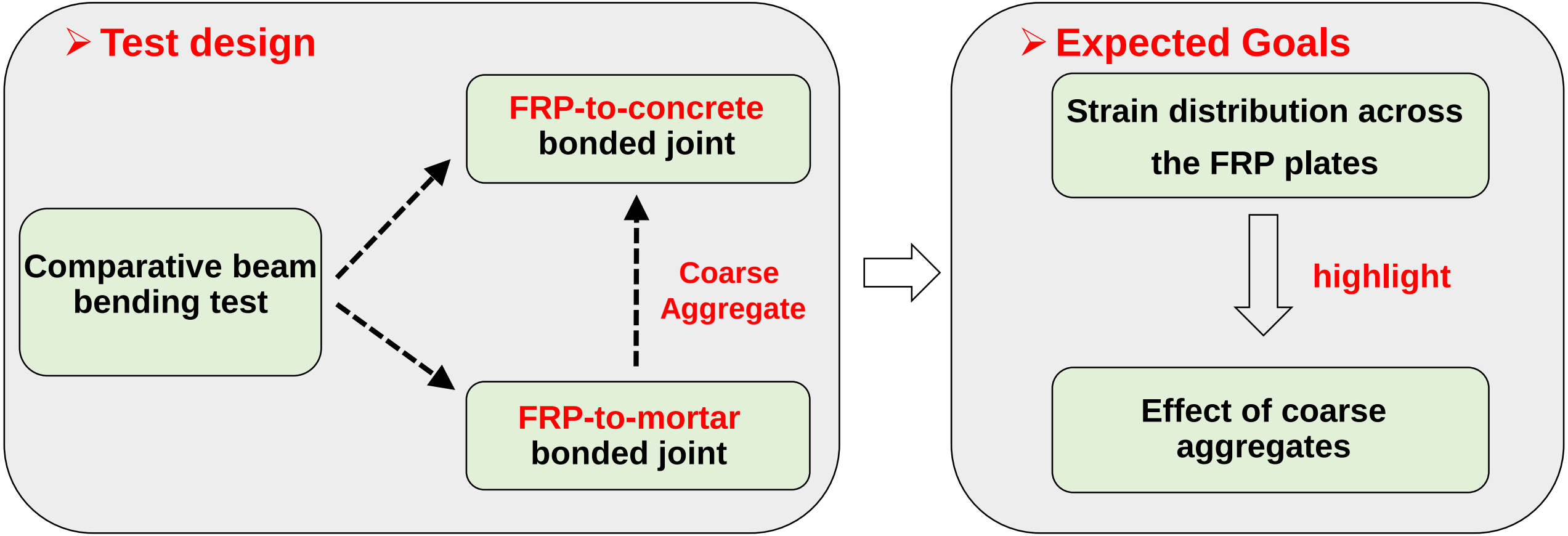
Experimental test design



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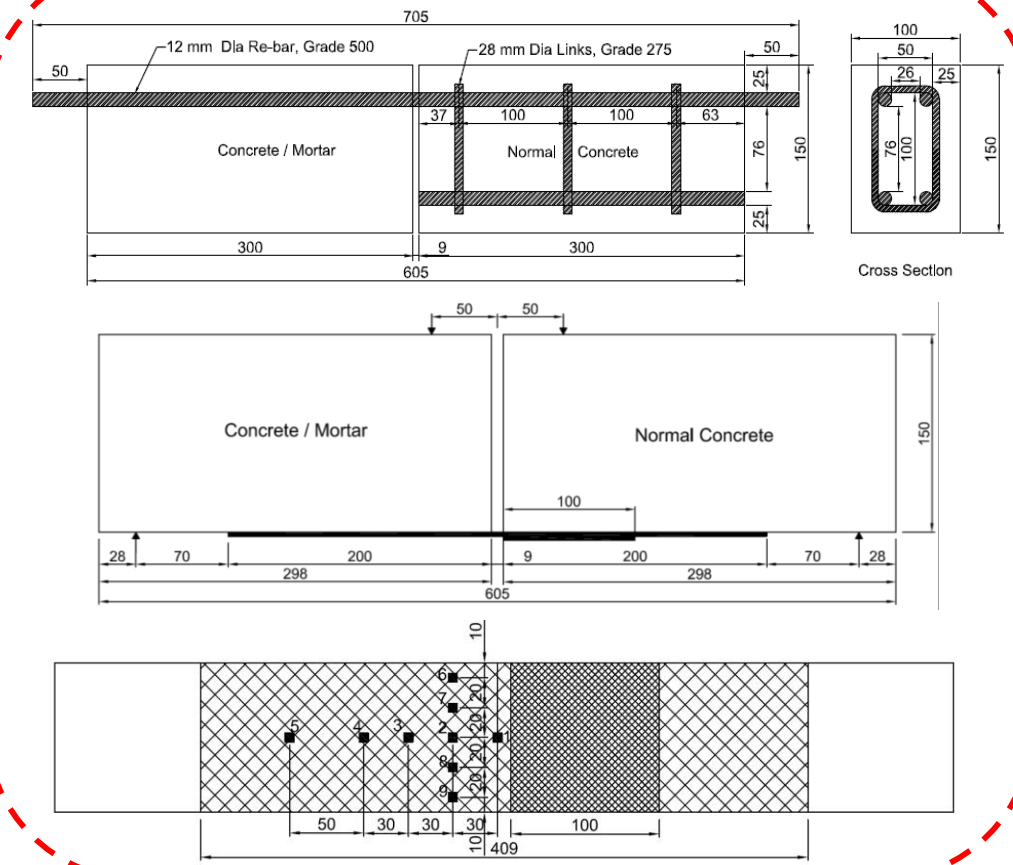
Test procedure



Specimen details

Experimental setup

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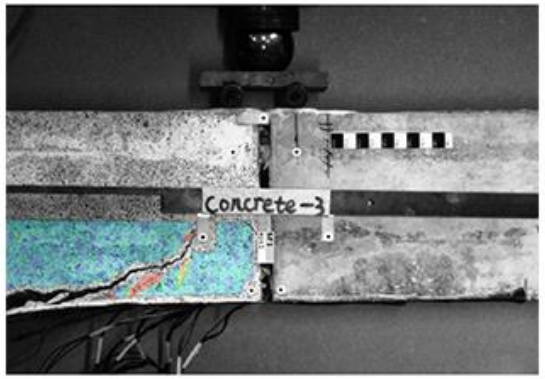
Summary of the results

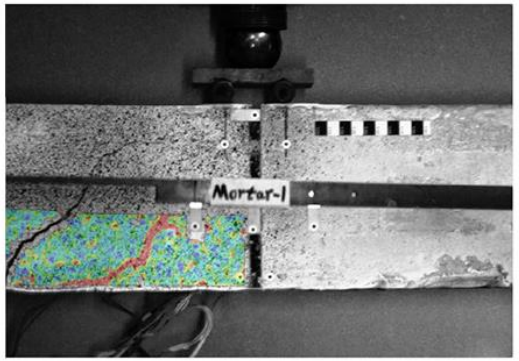
Test	C-1	C-2	C-3	M-1	M-2	M-3*
Failure mode	DB-SCI	DB-SCI	DB-SCI	BF	DB-SCI	DB-SCI
Peak Force (kN)	29.6	26.8	23.1	22.4	22.0	27.8
Mid-span deflection at failure (mm)	1.48	1.68	1.21	1.33	1.11	1.26



3 concrete specimens and

2 mortar specimens

Debonding - shear crack-induced (DB-SCI):



Only 1 mortar specimen

Block failure (BF):

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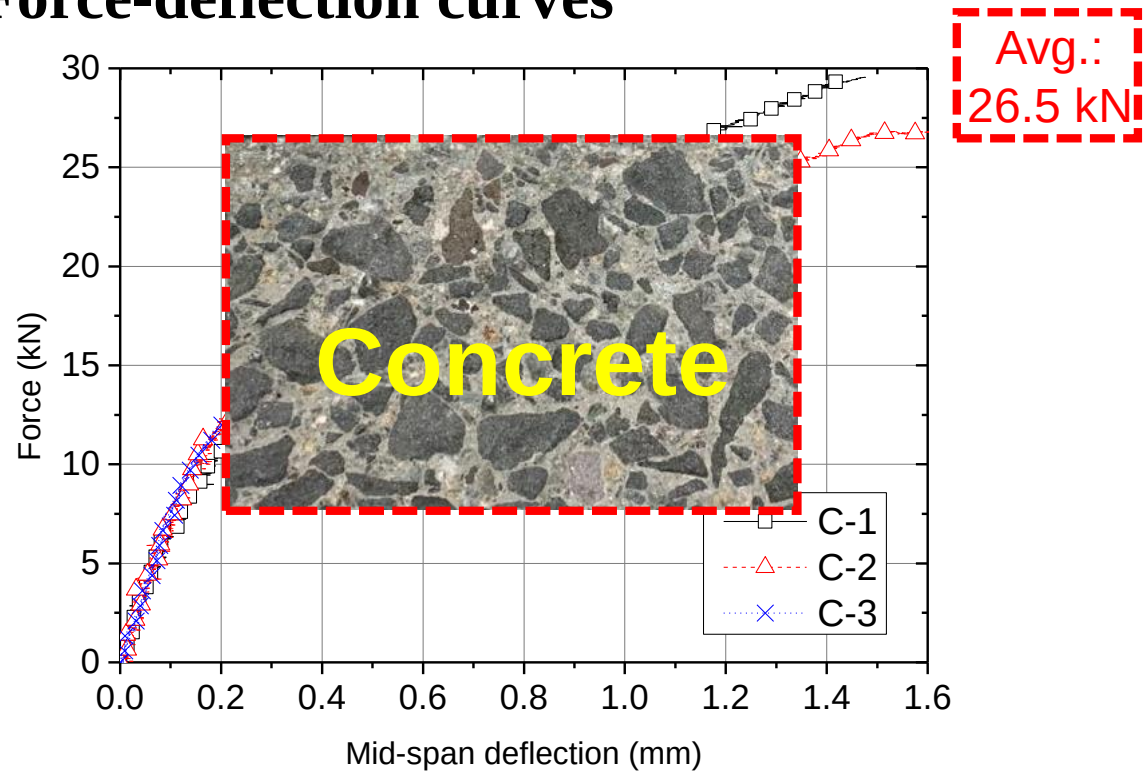
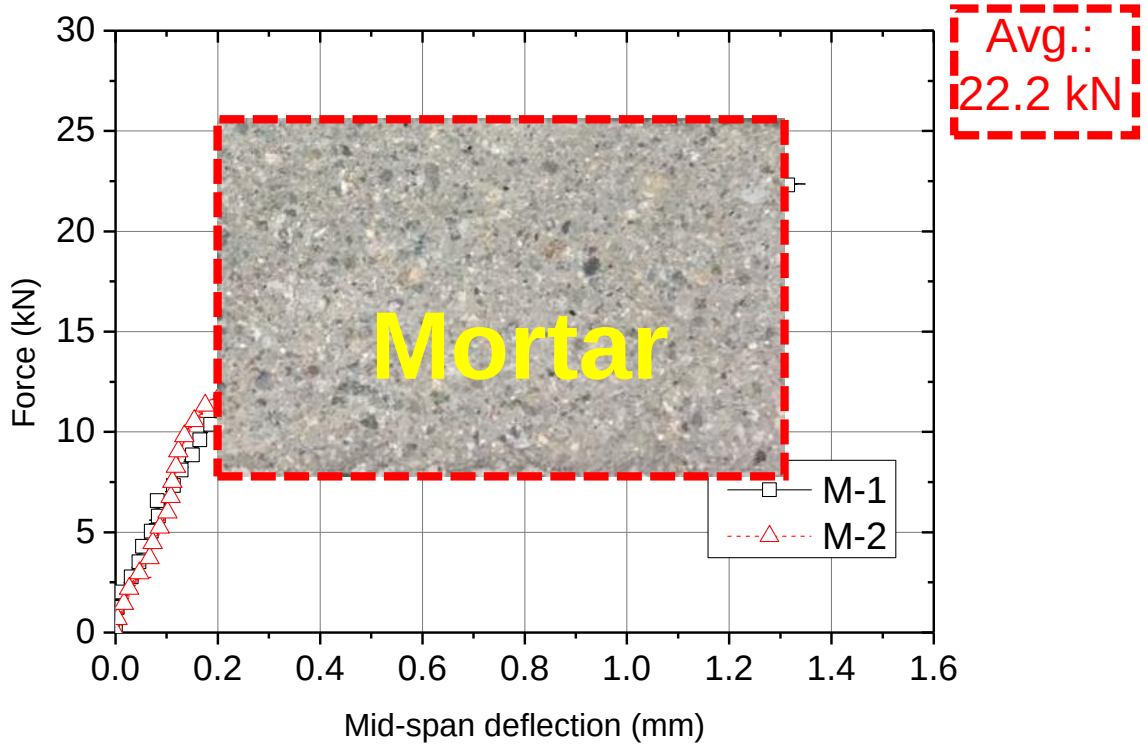
Summary of the results

➢ **Force-deflection curves**



FRP-concrete specimens



FRP-mortar specimens

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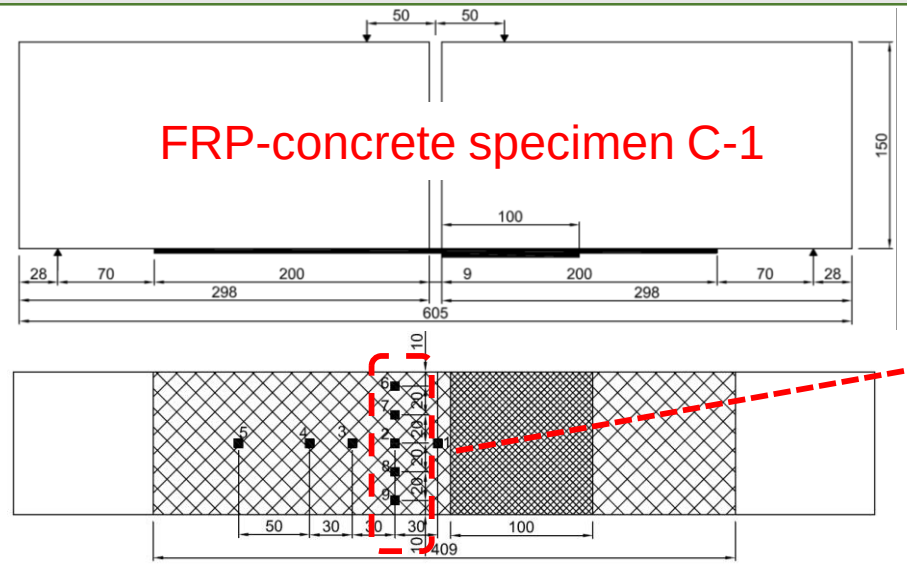
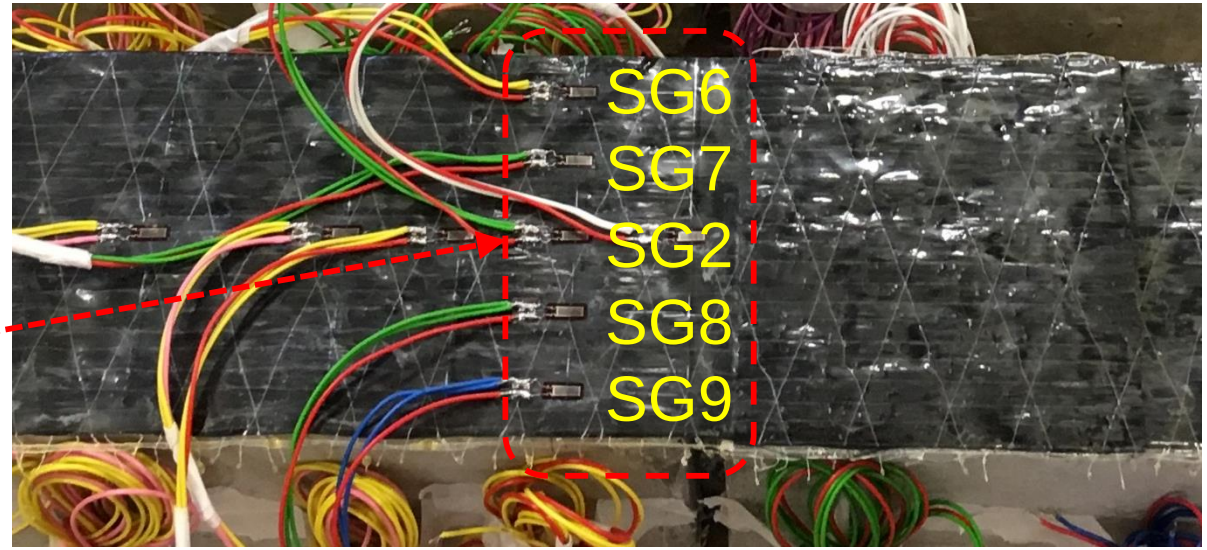
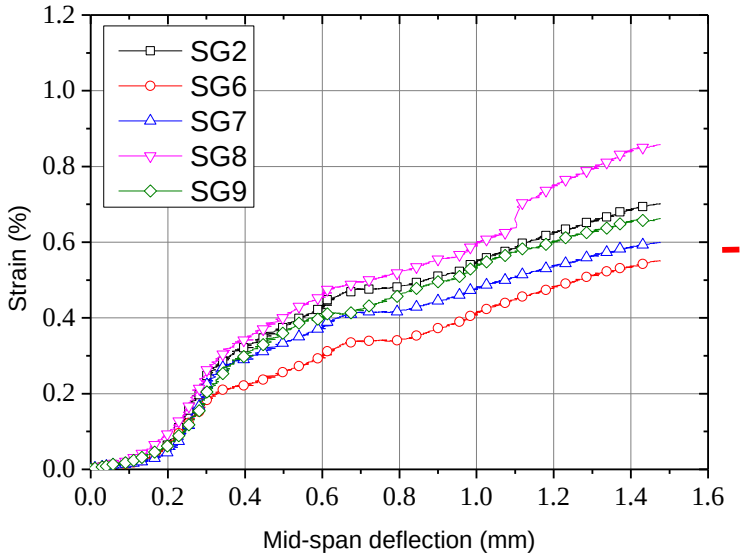
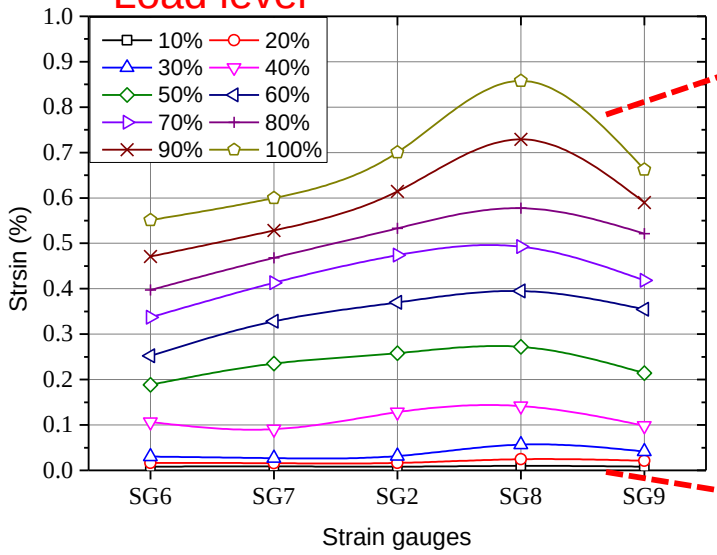
Strain analysis procedure









Strain profile

Coefficient of variation (CoV):

17.4%
16.5%
13.8%
14.3%
16.1%
14.2%
19.6%
32.3%
20.4%
9.1%

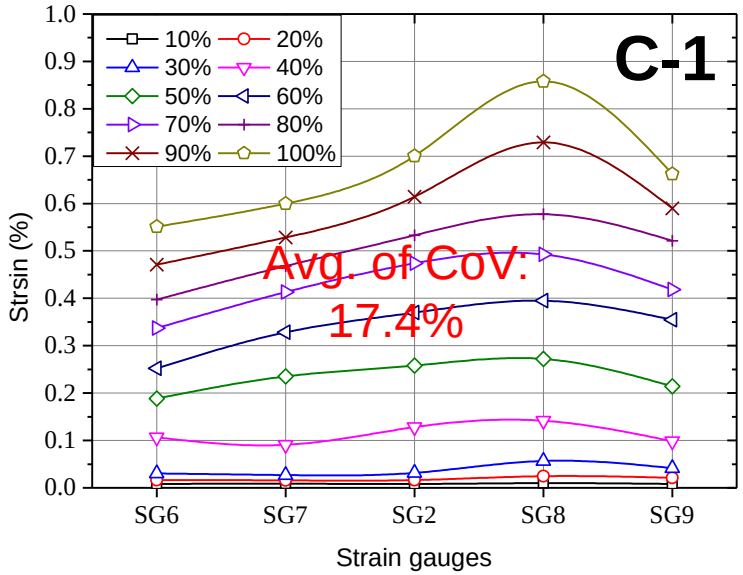
Avg. of CoV: 20.6%

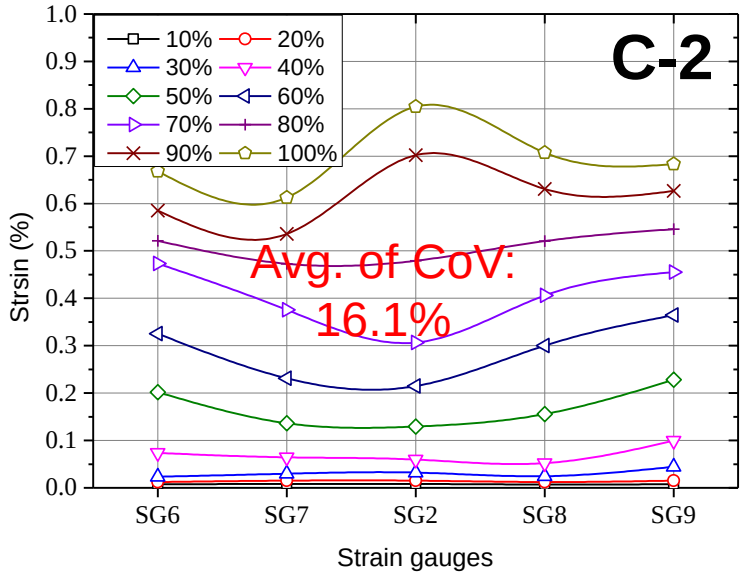
Avg. of CoV: 17.4%

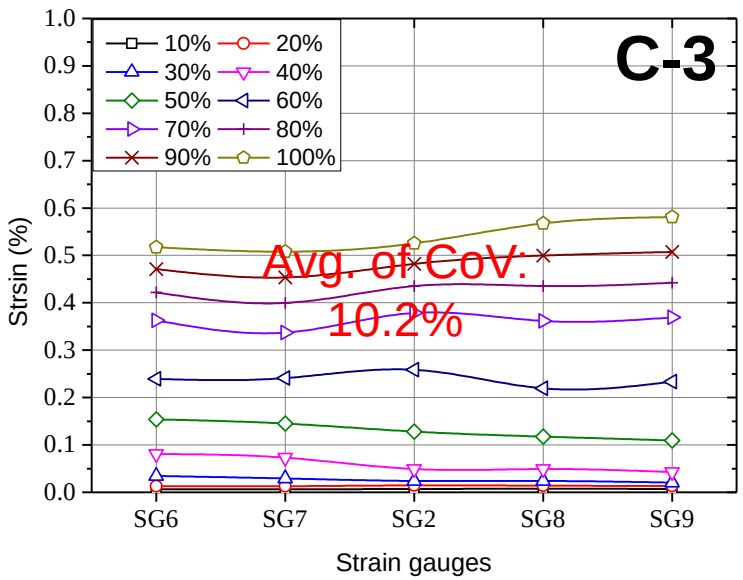
Strain distribution across FRP width

FRP-concrete specimen

Avg.: 14.6%

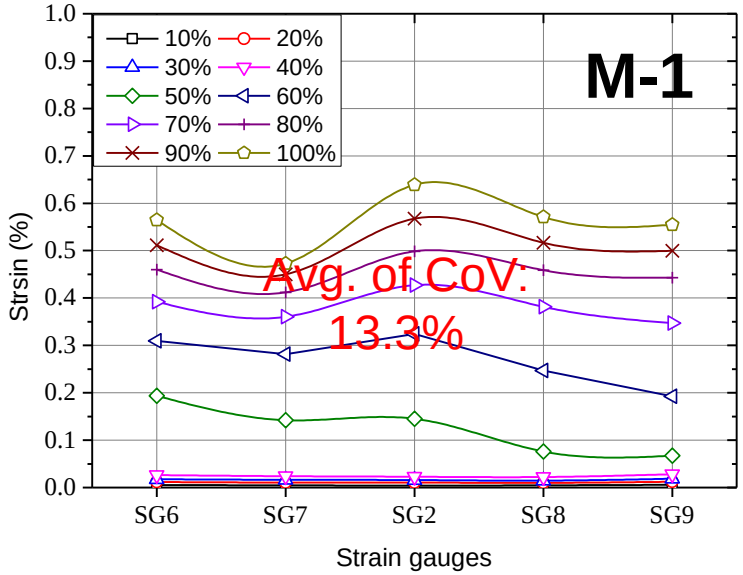


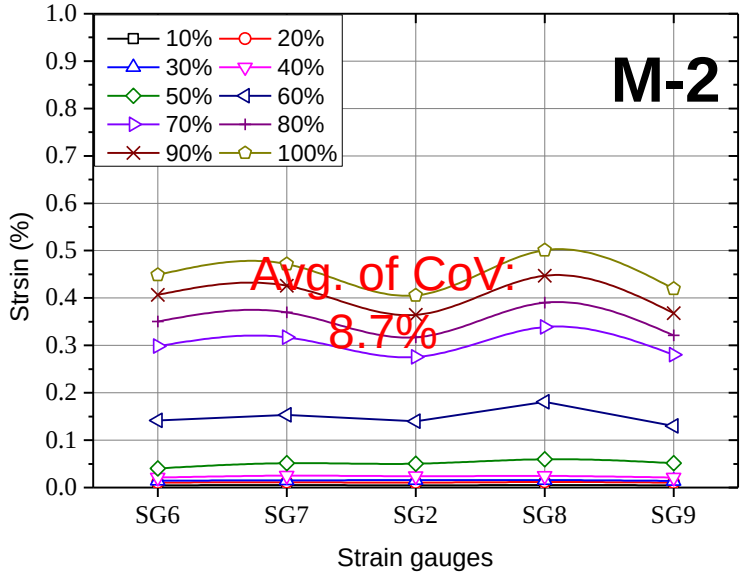


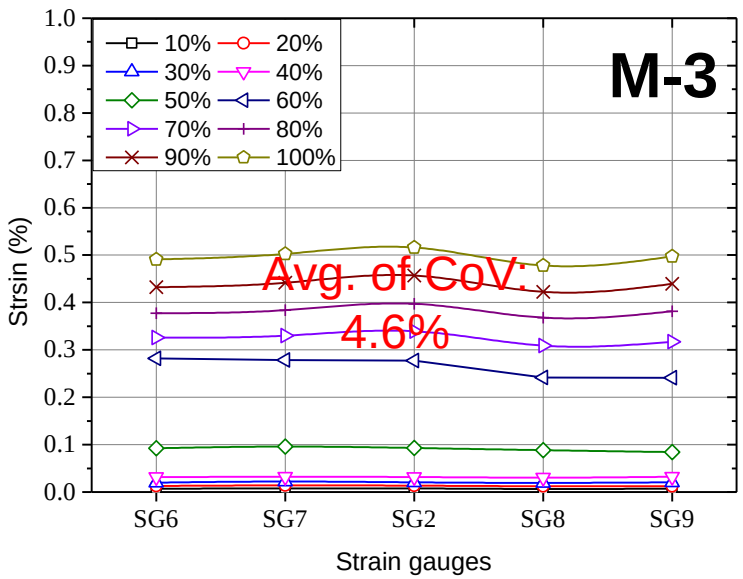


FRP-mortar specimen

Avg.: 8.8%



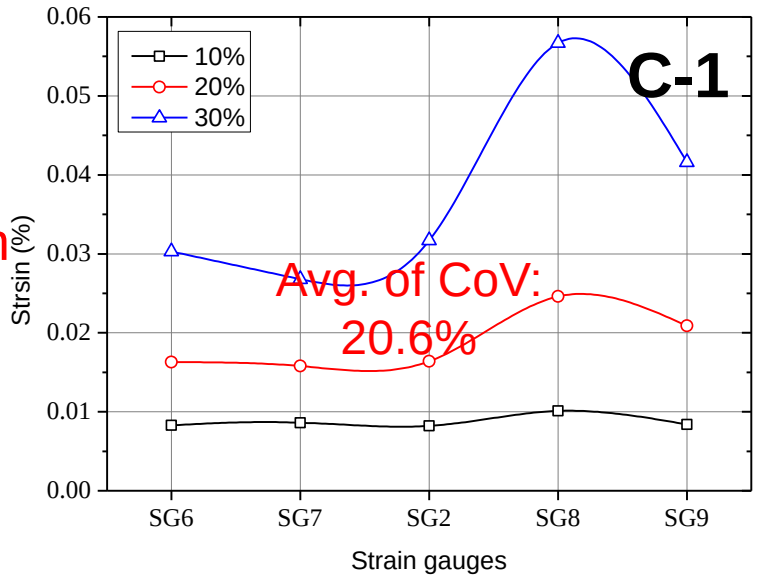


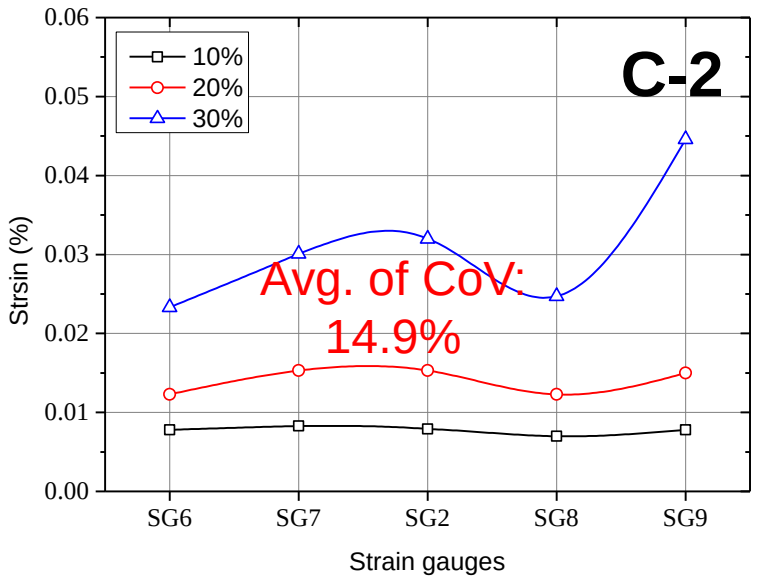


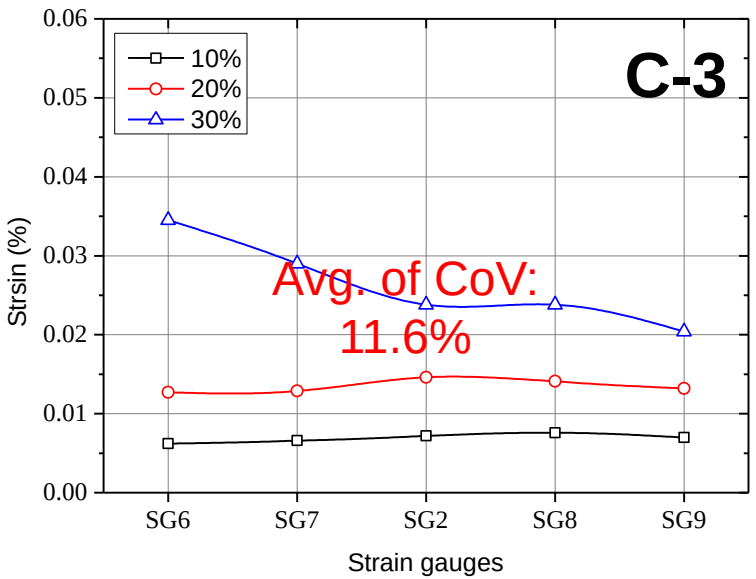
Strain distribution across FRP width

FRP-concrete specimen

Avg.: 15.7%

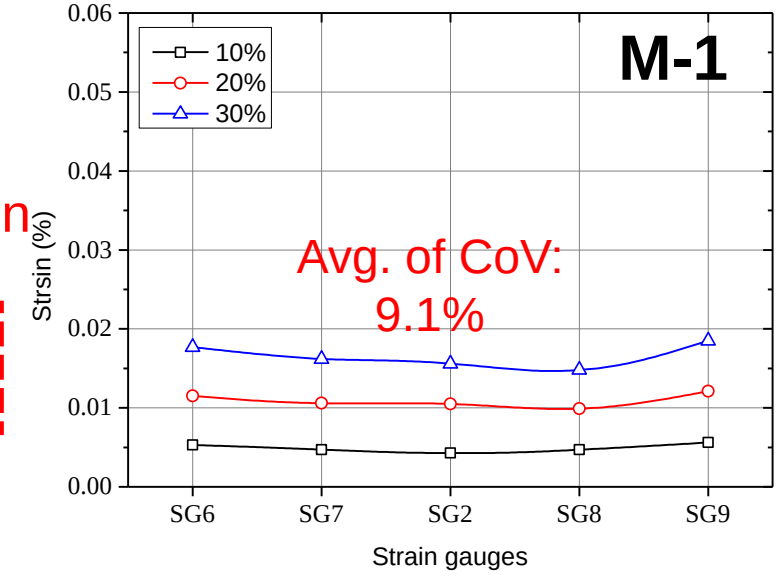


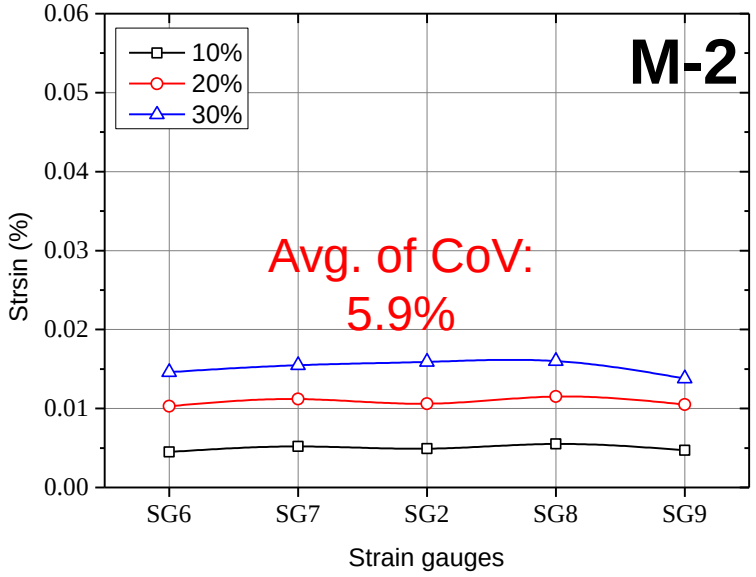


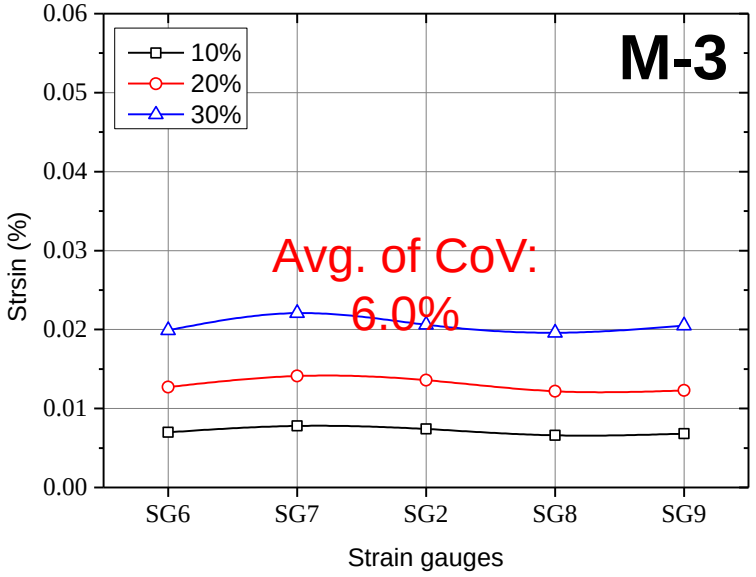


FRP-mortar specimen

Avg.: 7.0%







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Conclusions

- The test results confirmed that the presence of coarse aggregates results in a remarkable variation (more than twice as much as that in mortar) in the FRP strain distribution across the width of the FRP.

- The bond strength of FRP-to-concrete interface is significantly higher than that of FRP-to-mortar interface.

Aggregates plays an important role in FRP-to-concrete bond behaviour, and the effect of coarse aggregates on the FRP-to-concrete bond behaviour should not be ignored in both theoretical models and FE simulation

Thank You

Do you have any questions?

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