Grand Hornu (Mons)
Coal mining complex
UNESCO 2012 / MAC

Damage progress assessment on textile reinforced cement retrofit patches attached to traditional masonry using acoustic emission

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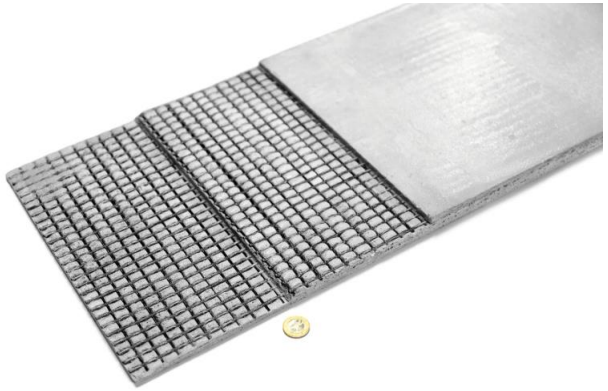
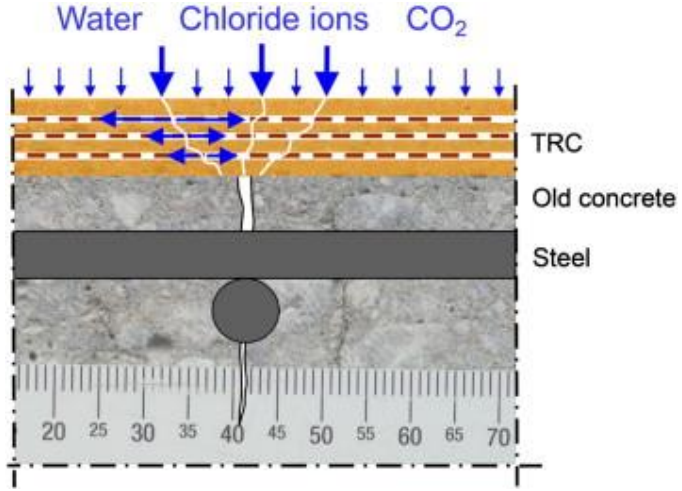
VUB VRIJE UNIVERSITEIT BRUSSEL

MeMC MECHANICS OF MATERIALS AND CONSTRUCTIONS

Textile reinforced cement (TRC) repair solution





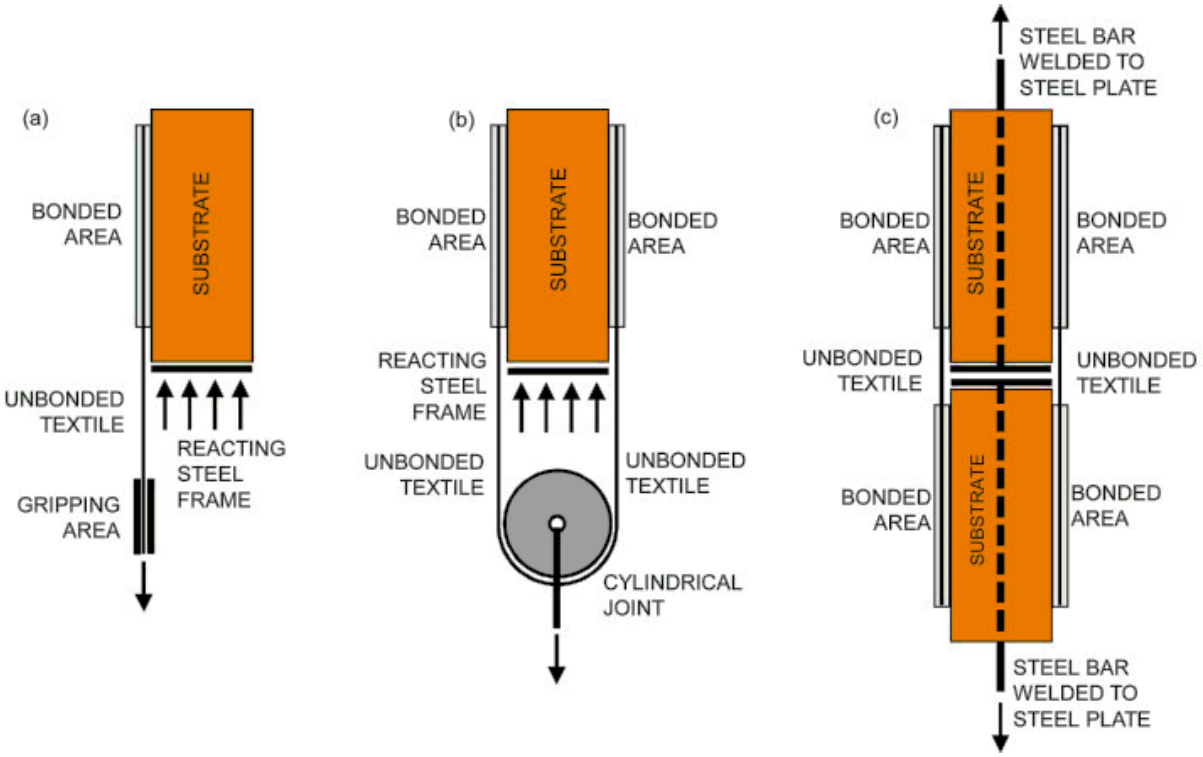
TRC repair patch for the restoration of masonry heritage structures

substrate

bond to substrate

TRC to masonry substrate bond

Complex testing procedure



10.1016/j.compositesb.2017.03.016

Materials and Structures (2018) 51:95
https://doi.org/10.1617/s11527-018-1216-x

RILEM TECHNICAL COMMITTEE

Recommendation of RILEM Technical Committee 250-CSM: Test method for Textile Reinforced Mortar to substrate bond characterization

Gianmarco de Felice · Maria Antonietta Aiello · Carmelo Caggegi · Francesca Ceroni · Stefano De Santis · Enrico Garbin · Natalino Gattesco · Łukasz Hojdys · Piotr Krajewski · Arkadiusz Kwiecień · Marianovella Leone · Gian Piero Lignola · Claudio Mazzotti · Daniel Oliveira · Corina Papanicolaou · Carlo Poggi · Thanasis Triantafillou · Maria Rosa Valluzzi · Alberto Viskovic

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Abstract Textile Reinforced Mortar (TRM), also known as Fabric Reinforced Mortar or Fabric Reinforced Cementitious Matrix, composites are an emerging technology for the external repair and strengthening of existing structures. For most applications, the effectiveness of the TRM reinforcement relies on its bond performance. This recommendation behaviour of TRM. A shear bond test method is proposed to determine the peak axial stress (associated with the maximum load that can be transferred from the structural member to the externally bonded TRM reinforcement), the stress–slip relationship and the failure mode that controls the TRM-to-substrate load transfer capacity. Guidelines on specimen

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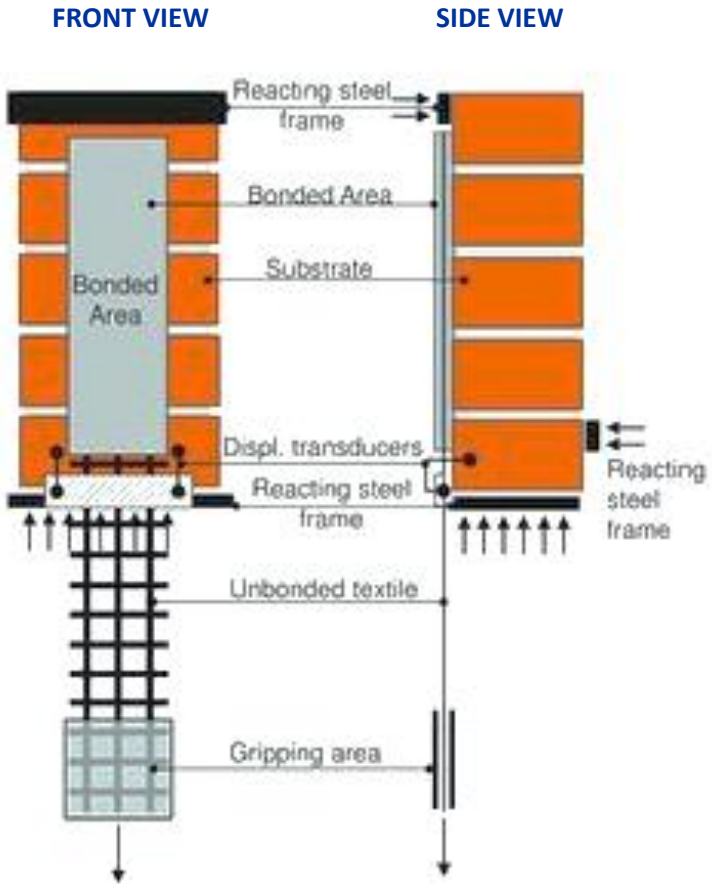

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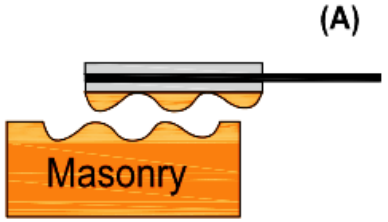
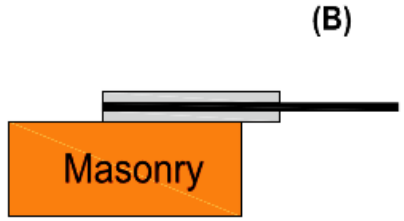
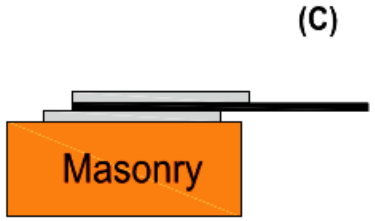


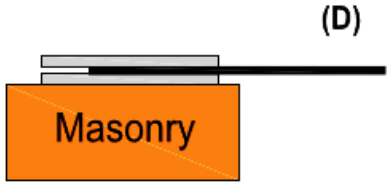
Cohesive debonding in the substrate



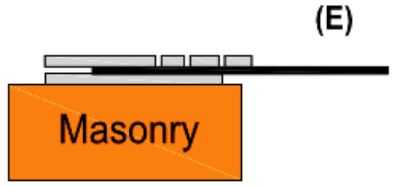
TRC-substrate detachment



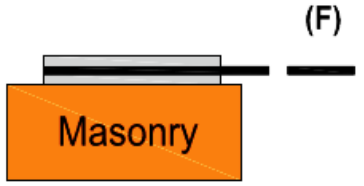
Textile-cement detachment



Textile sliding within cement



Textile and cement failure



Textile failure

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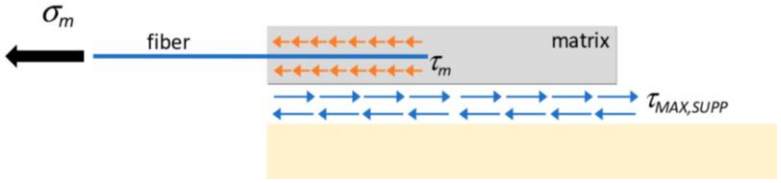

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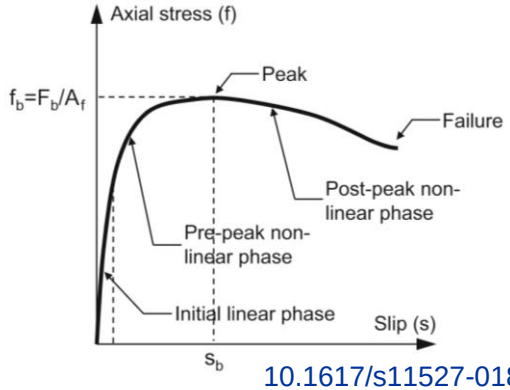


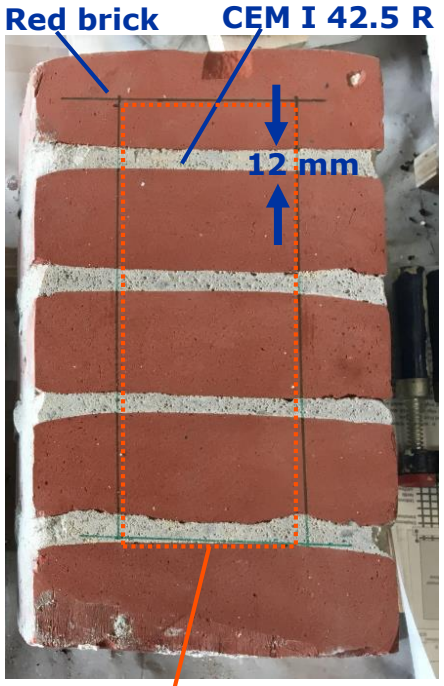
10.1617/s11527-018-1216-x

TRC-substrate samples preparation and casting

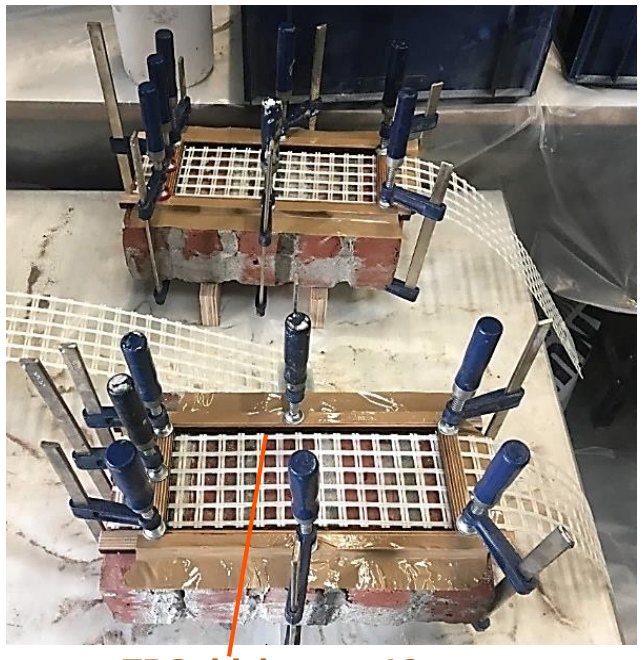
Wall construction
supported & leveled
28 days curing

! Bricks irregularity

Surface roughness:
Rough (no preparation)
Smooth (grinder used)



Bonded area=100x250mm



TRC thickness=10mm

Wood formwork
Textile clamped between formwork blocks

	Mesh (mm)	Tens. strength (Mpa)	Density (g/m²)	E (Gpa)
SITGRID 200	17.5	526	653	67
SITGRID 017	13	814	578	93
SITGRID 701	22.5	496	308	67

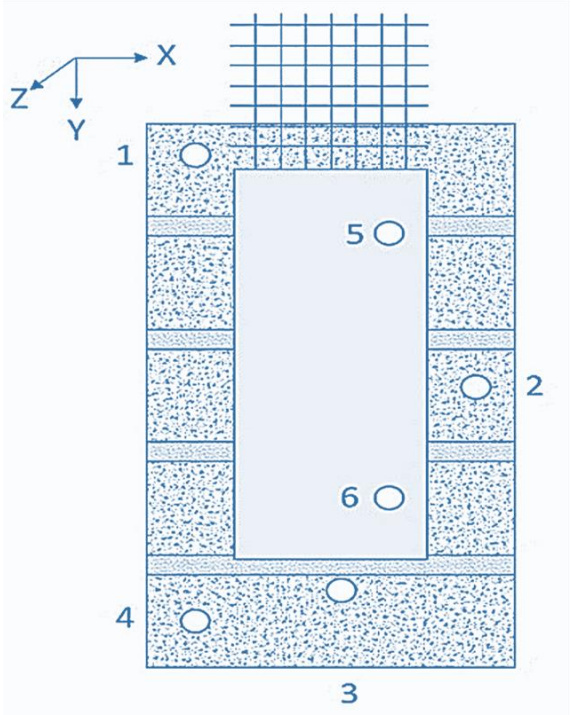
TRC-substrate samples test set-up, support setting and testing

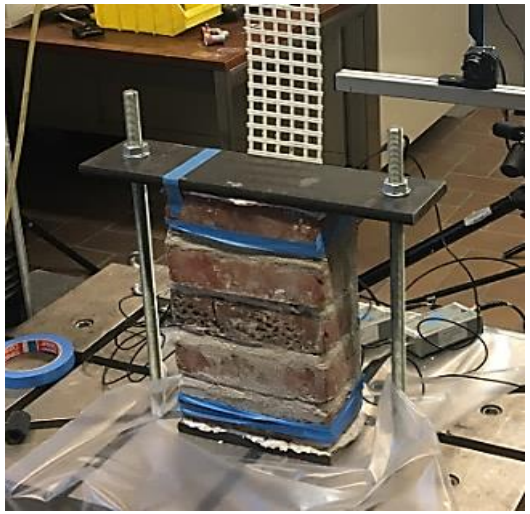
RILEM TC 250-CSM
Grips to Instron: pair of aluminum plates + epoxy glue (100x60x2mm)

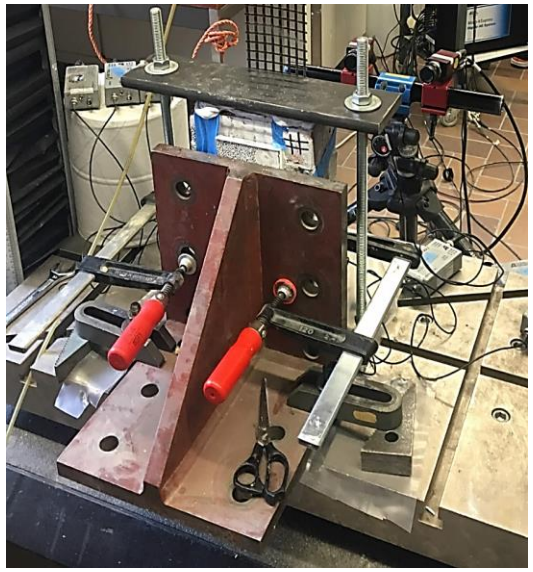
Instron5885 100kN load cell
Test rate: 0.2 mm/min

“Reacting Steel Frame”

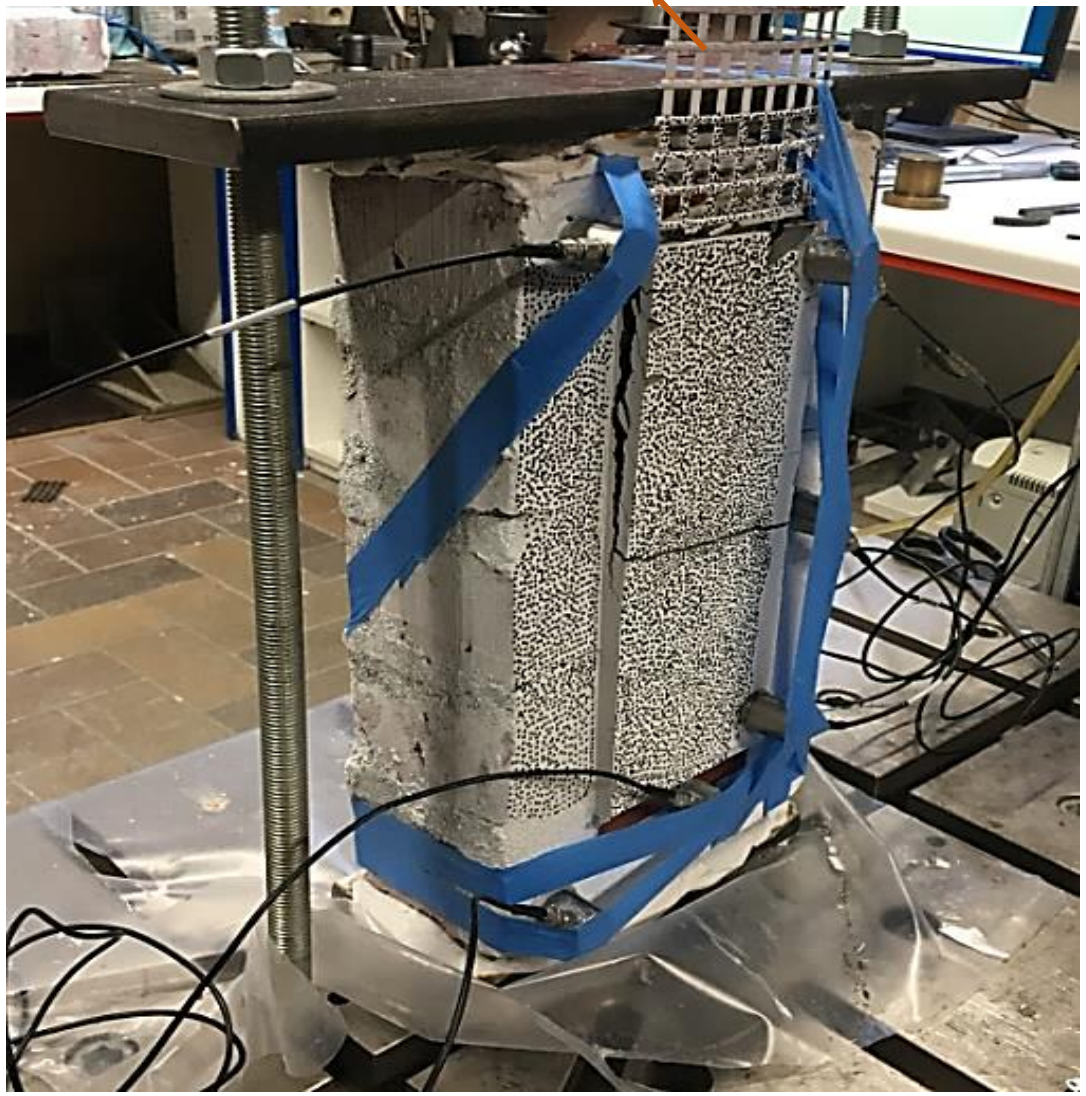
Plaster at top/bottom + fastened steel plates





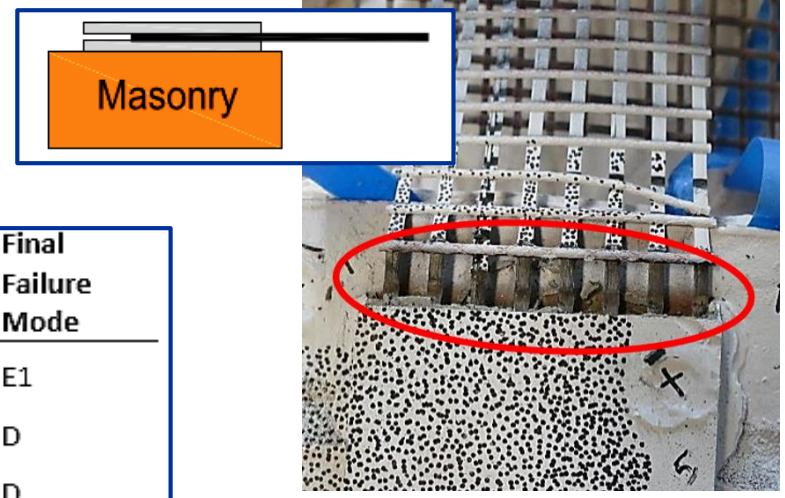


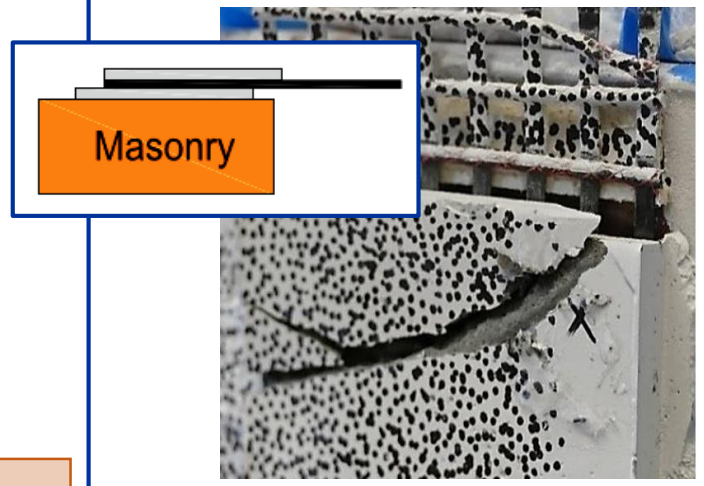
Unbonded length=400mm

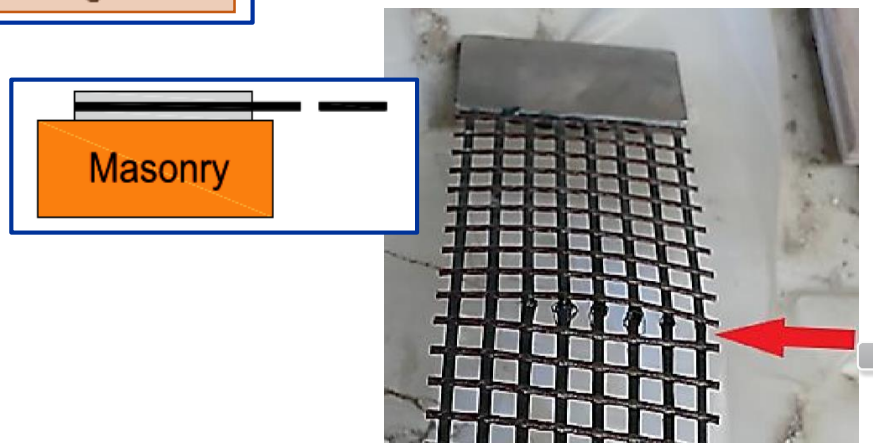


TRC-substrate bond tests results

Textile Material	Surface Treatment	Support System	Fiber Volume Fraction	Specimen Number	Ultimate Load	Displacement at Ultimate Load	Load at 1st TRC-Masonry Debonding	Final Failure Mode
Glass	Rough	Free	Low Vol Frac	1	2.9 kN	8.8 mm	N/A	E1
		Free	High Vol Frac	2	4.5 kN	7.0 mm	N/A	D
	Smooth	Free	High Vol Frac	1	4.1 kN	11.5 mm	N/A	D
Carbon	Rough	Free	High Vol Frac	1	9.0 kN	9.5 mm	7.2 kN	D/C
		Free	High Vol Frac	2	10.3 kN	16.2 mm	8.4 kN	C
		Fixed	High Vol Frac	3	13.5 kN	12.3 mm	N/A	D
		Fixed	High Vol Frac	4	8.8 kN	8.0 mm	N/A	D/E1
		Fixed	High Vol Frac	5	9.5 kN	9.8 mm	8.6 kN	D/C
Carbon	Smooth	Free	High Vol Frac	1	8.7 kN	11.3 mm	7.0 kN	C
		Fixed	High Vol Frac	2	14.6 kN	13.8 mm	N/A	D/E1
		Free	High Vol Frac	3	13.8 kN	10.5 mm	12.5 kN	C

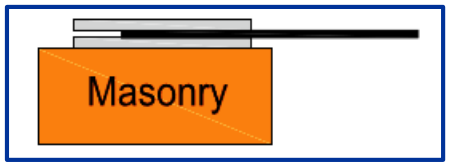


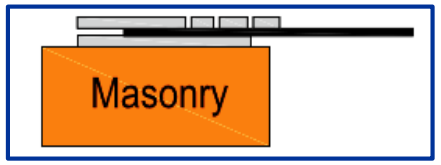


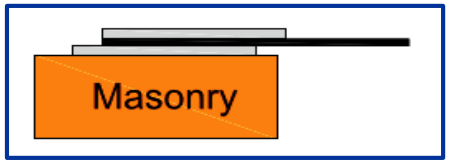


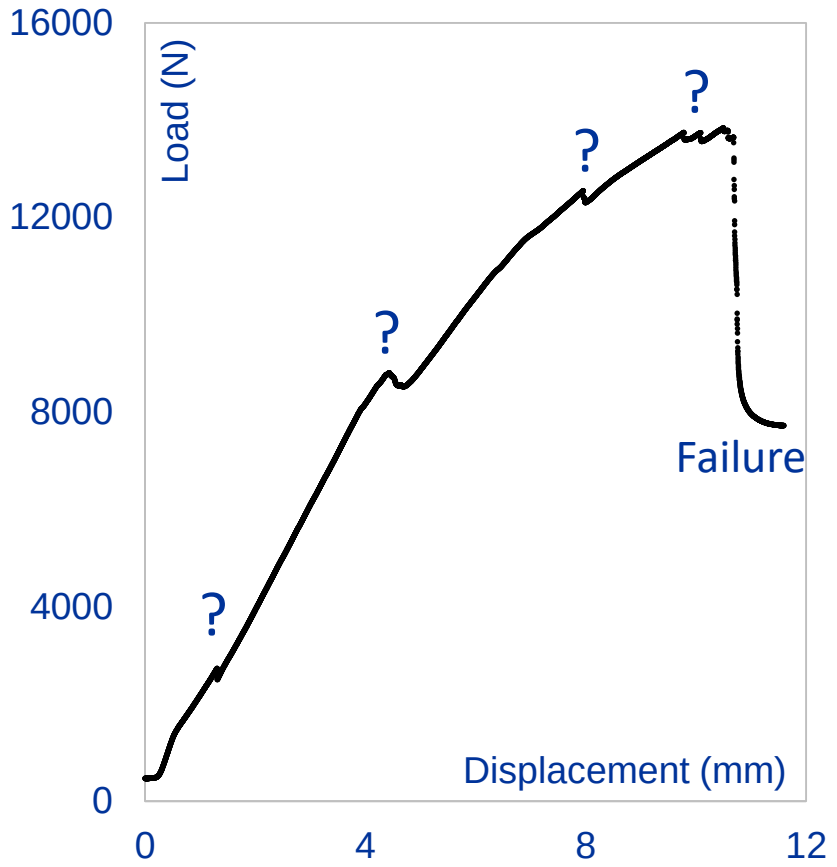
TRC-substrate bond tests results

Pictures taken after the test

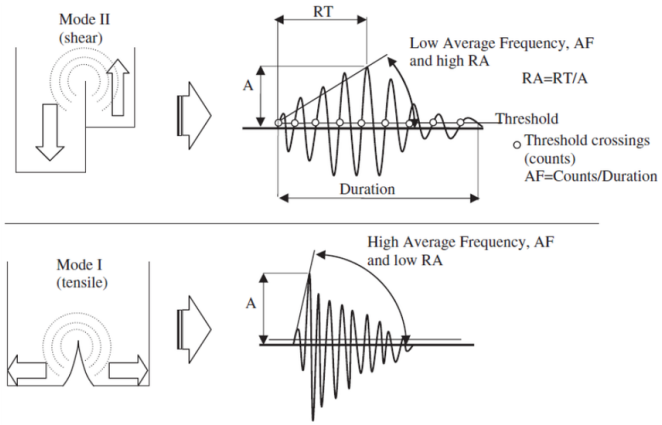






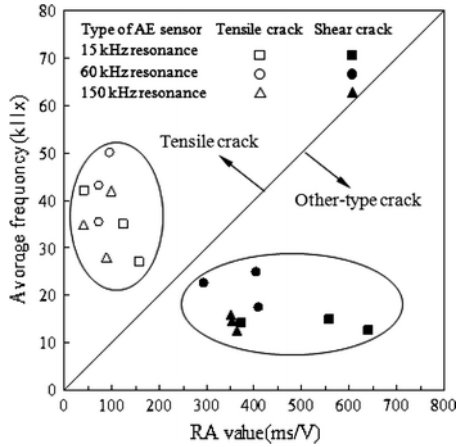


TRC-substrate bond tests results



https://www.ndt.net/article/jae/papers/29-057.pdf

RILEM TC 212-ACD: acoustic emission and related NDE techniques for crack detection and damage evaluation in concrete



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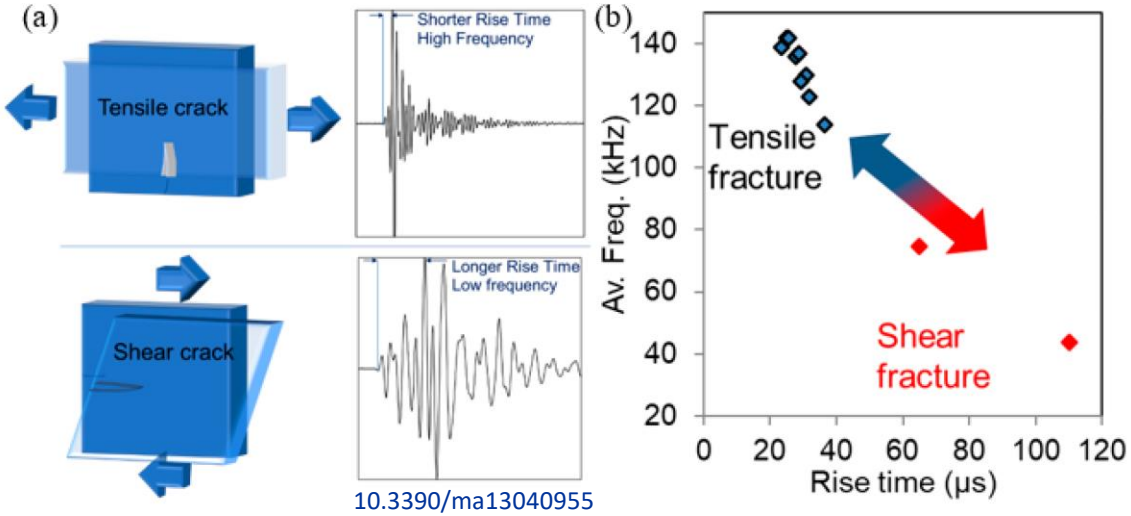

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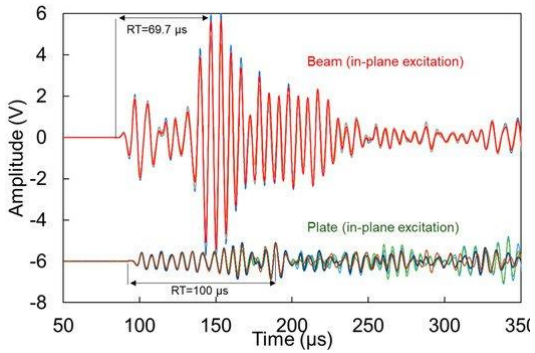
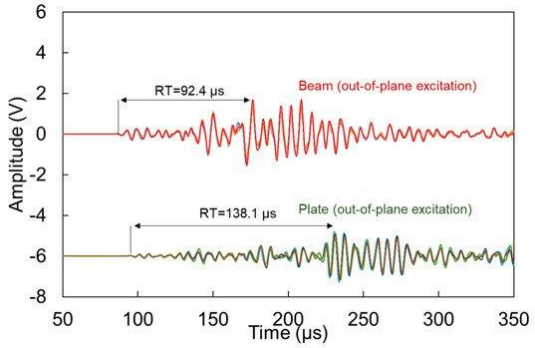


In-plane excitation on the side: beam & plate



Excitation on the surface: beam & plate

Open Access Article

Dimension Effects on the Acoustic Behavior of TRC Plates

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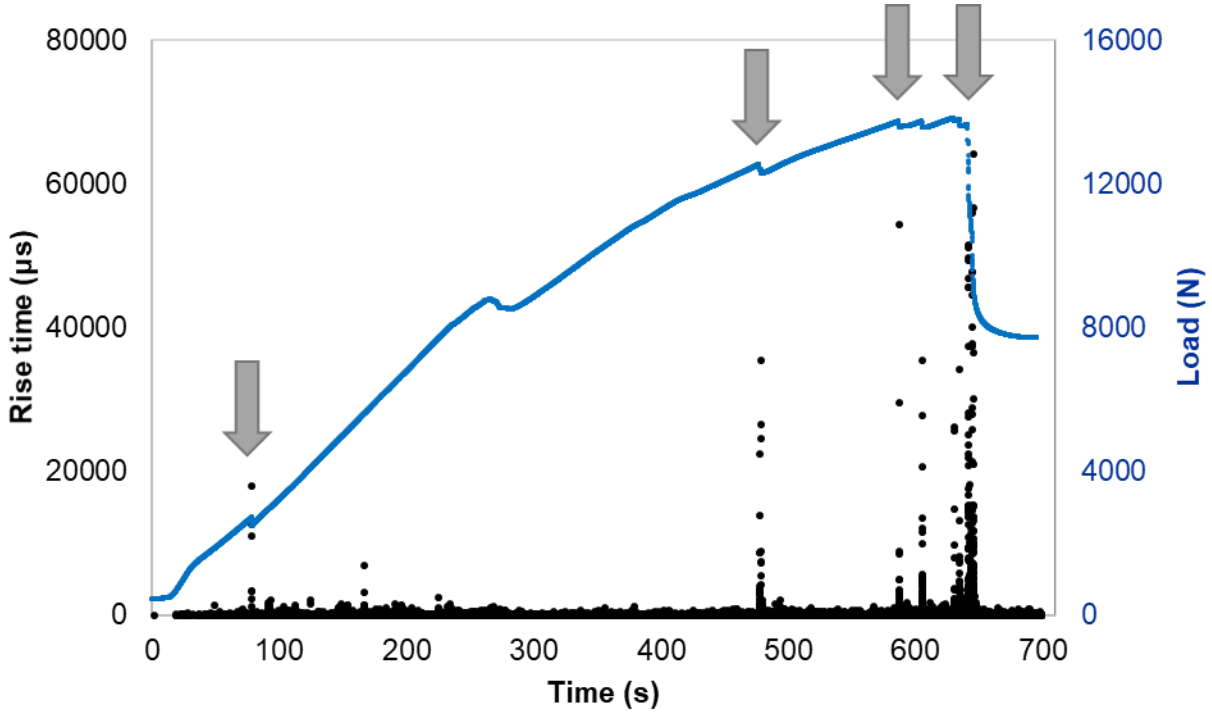
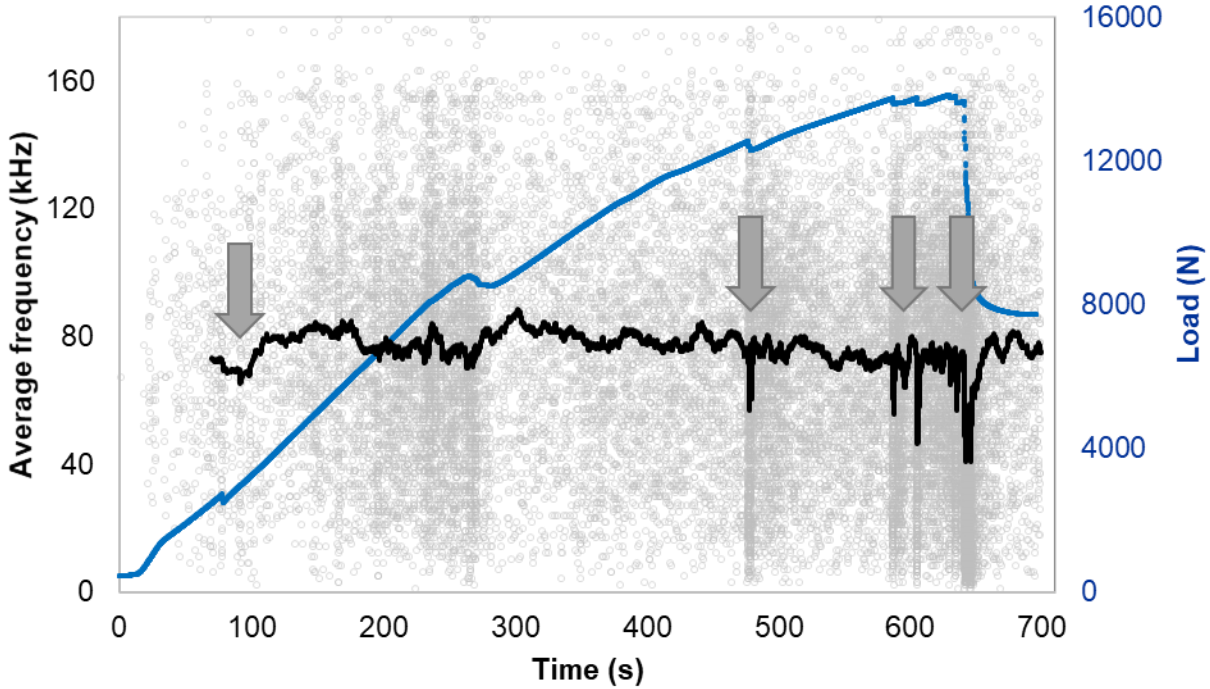
TRC-substrate bond tests results – AE hits analysis





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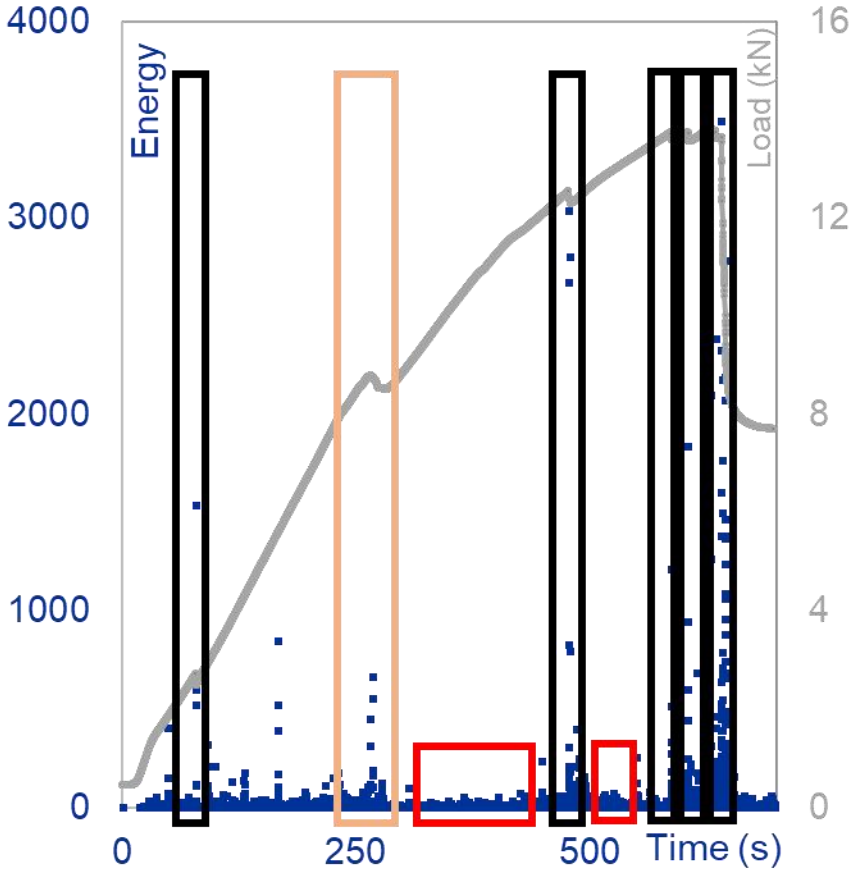

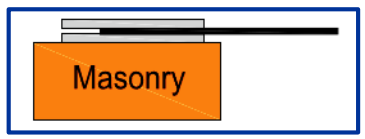

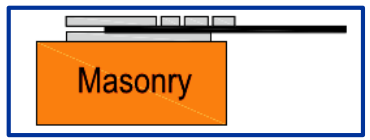

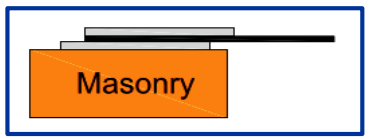

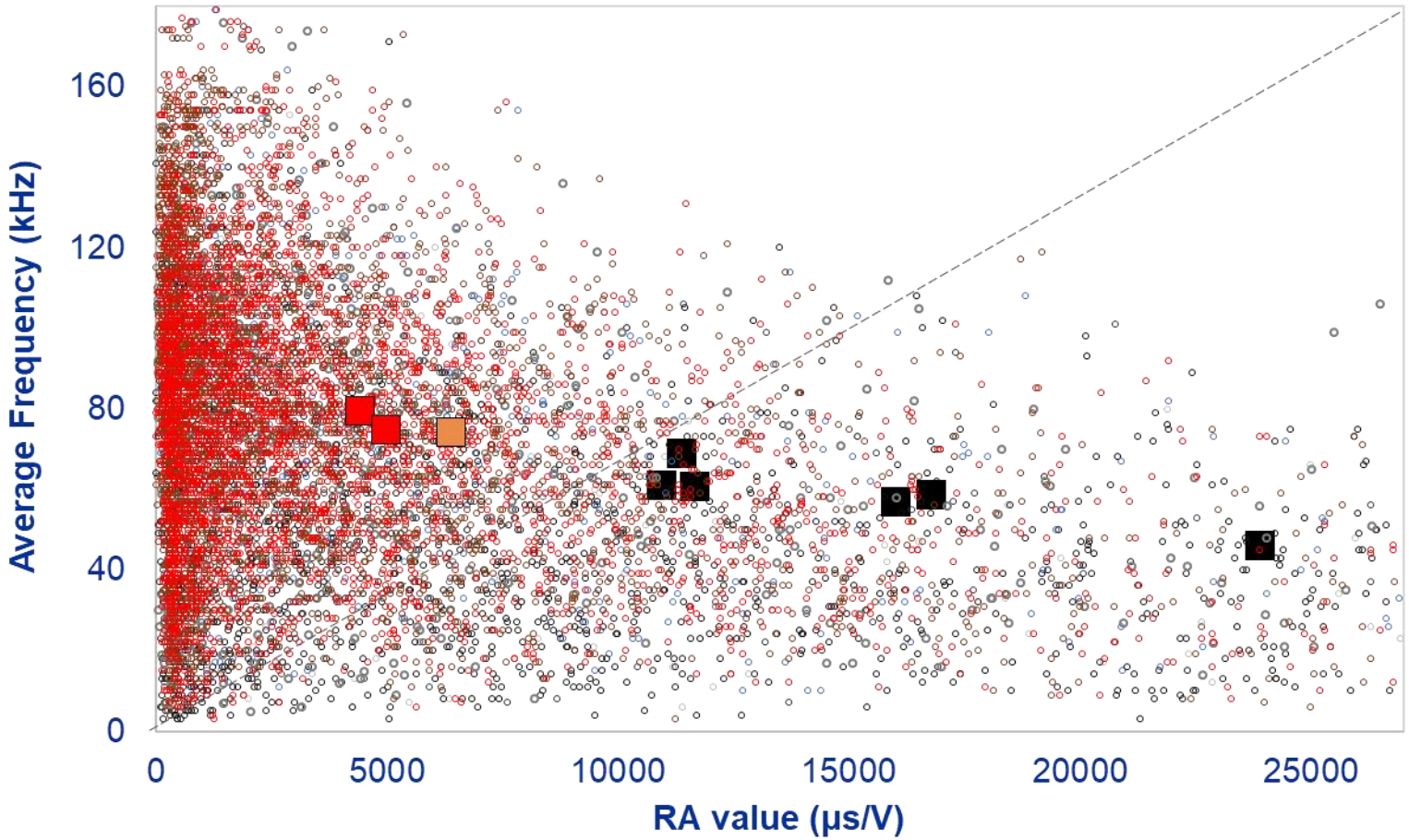

Conclusions

- ✓ Complex damage progress revealed only by using RT-AF AE parameter trends
- ✓ Damage characterisation based on failure modes
- ✓ Elimination of interference with secondary effects and noise
- ❑ Still tests to be done in other TRC materials and under dynamic service loads (ie. earthquake)

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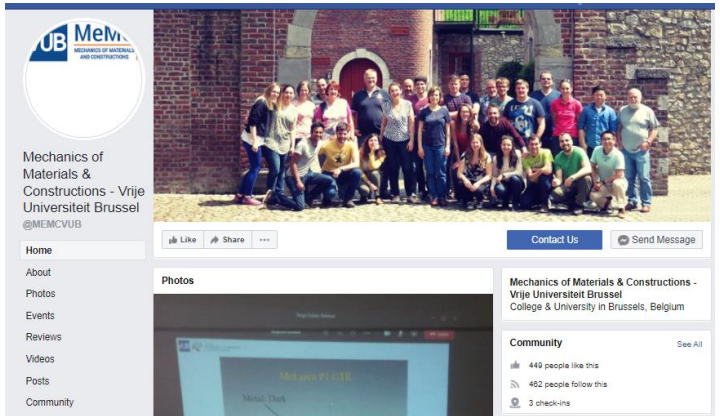

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