BOND BEHAVIOUR OF MULTI-LAYER SRG STRENGHTENING SYSTEMS TO CONCRETE

Sultan Alotaibi
Georgia Thermou
Iman Hajirasouliha
Maurizio Guadagnini

NetComposites
ACIC 2019
24-26 Sep 2019
Birmingham, UK

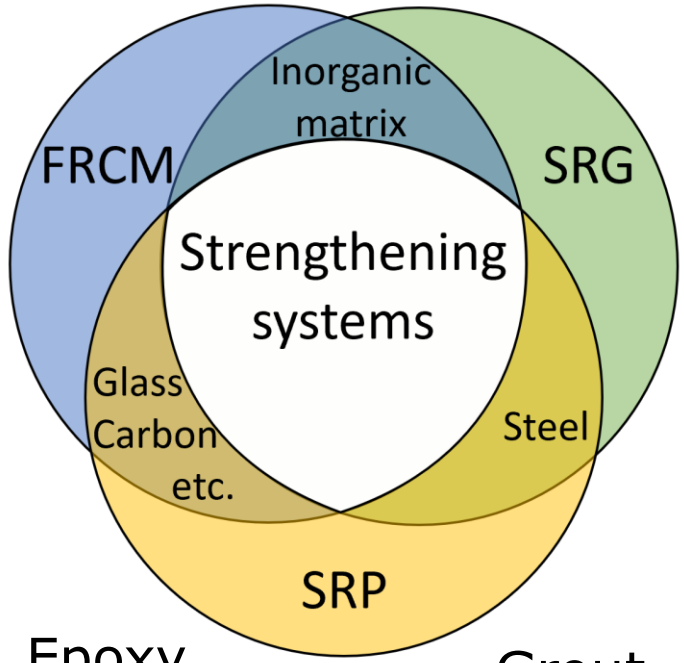
Shaqra University
The University Of Sheffield.
The University of Nottingham

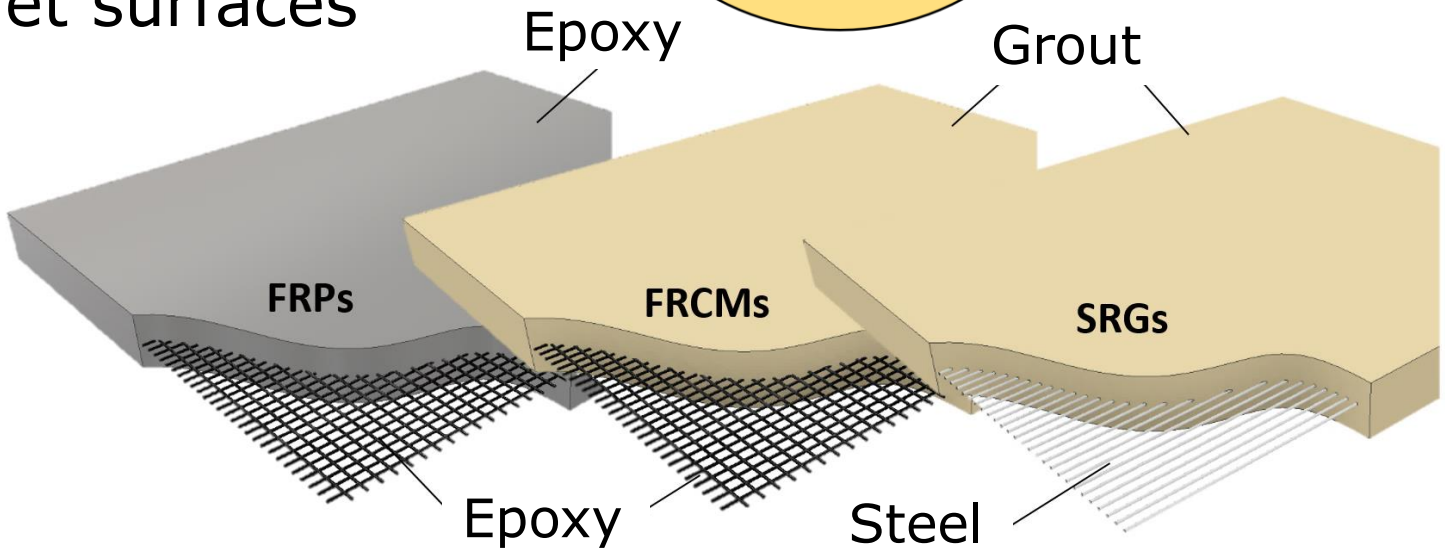
OUTLINE

- Introduction to SRG system
- Scientific issue
- Experimental programme
- Results and discussion
- Key findings

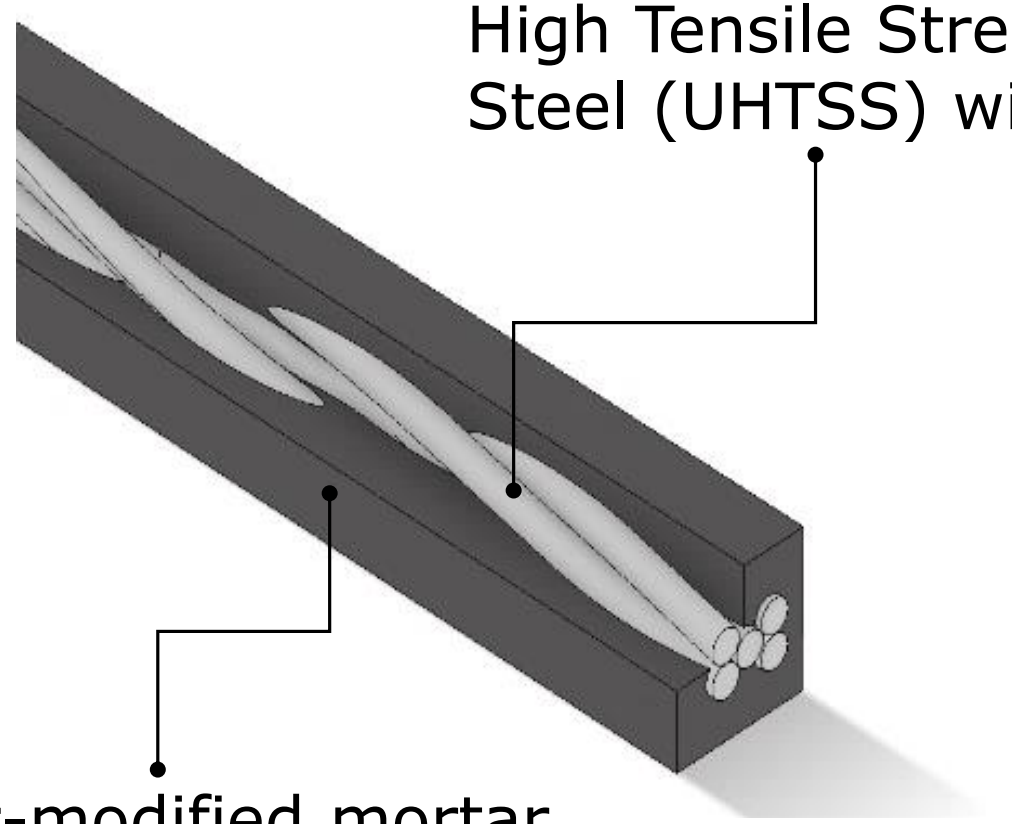
FRPs have some disadvantages:

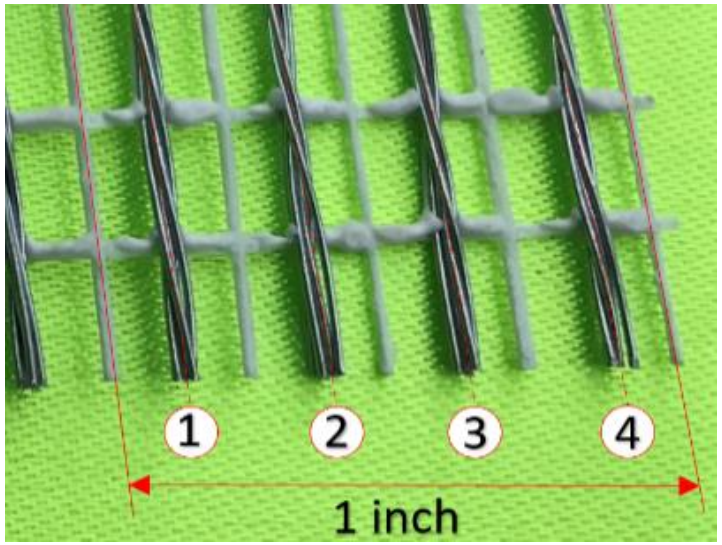
- Low performance in fire
- Limited applicability on wet surfaces
- relatively high cost

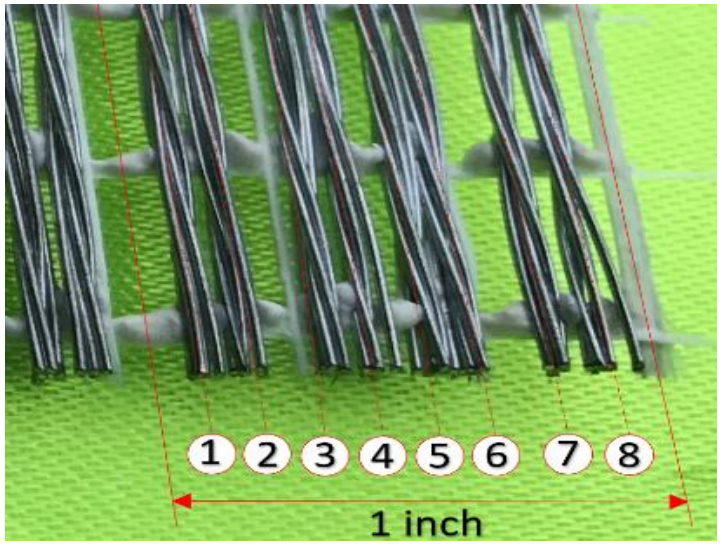




SRG Composite System







Past Research on SRG System

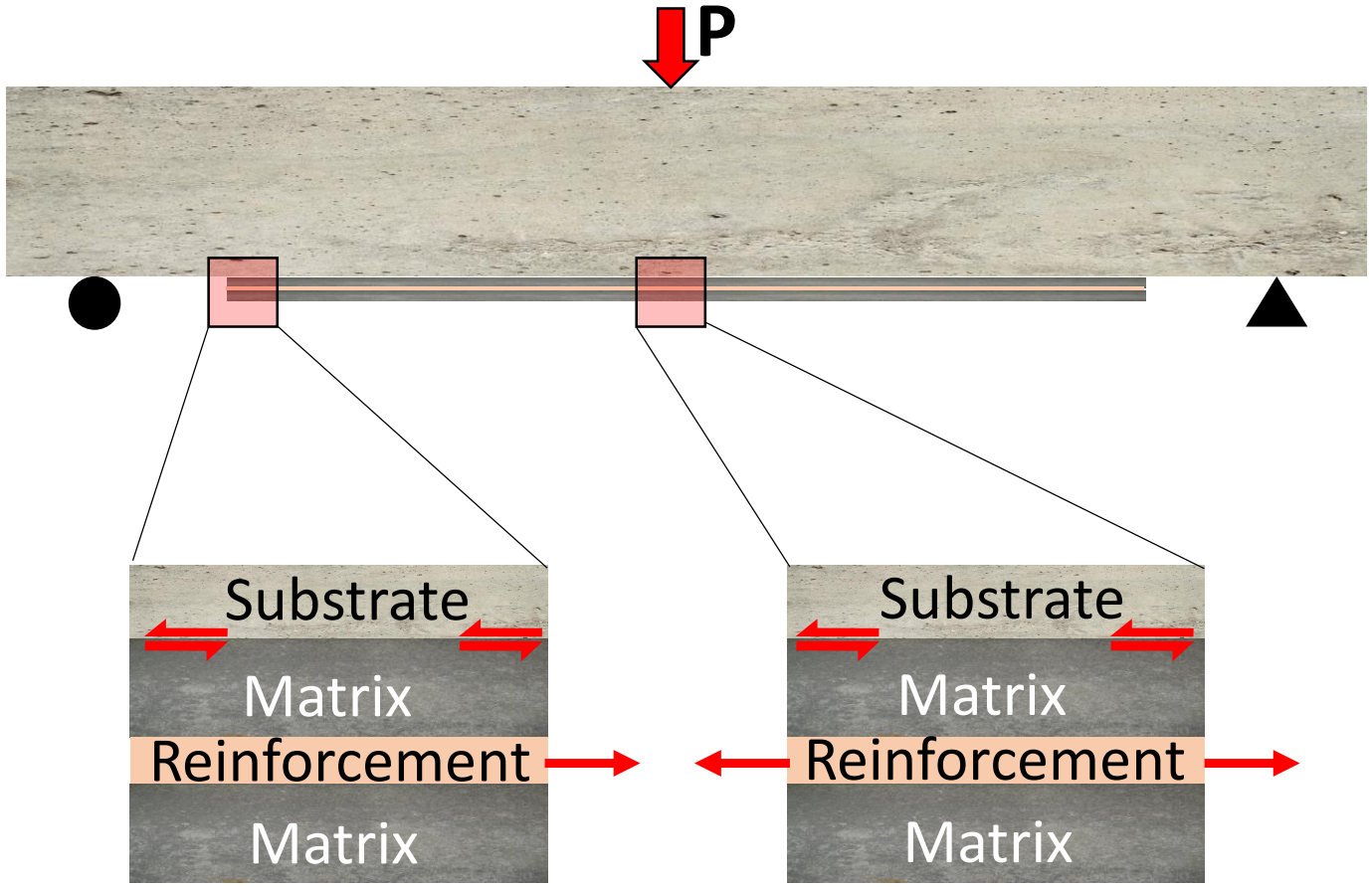
Different parameters were investigated including;

- Type of substrate (masonry and concrete)
- Type of steel cords (galvanized and stainless steel cords)
- density of cords (4, 8, 12, and 23 cord/in)
- Type of matrix (lime-based, geopolymer, and fibre-reinforced)
- Bond length (100 to 400mm)

SCIENTIFIC ISSUE

Some large structural members require applying more than one layer of composite to achieve the desired capacity.

- The tensile behaviour of the strengthening composite
- The bond behaviour between the composite and the member



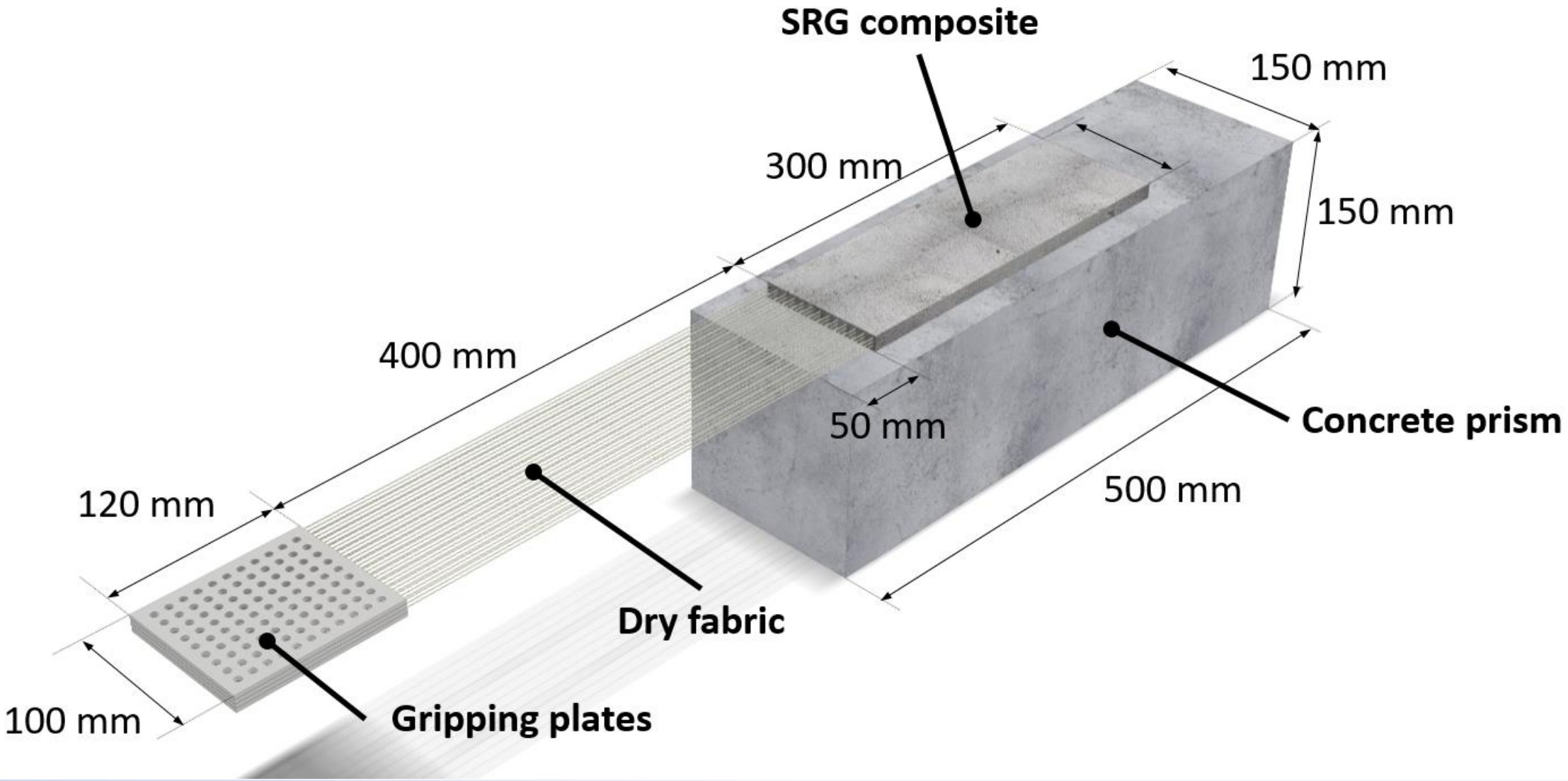
EXPERIMENTAL PROGRAMME

- Number of steel fabric layers (1, 2, and 3 layers)
- Density of steel fabric (4 and 8 cord/in)

Density of steel fabric	Number of steel fabric layers		
	1 Layer	2 Layers	3 Layers
4 cord/in	SB-L41	SB-L42	SB-L43
8 cord/in	SB-L81	SB-L82	SB-L83

EXPERIMENTAL PROGRAMME

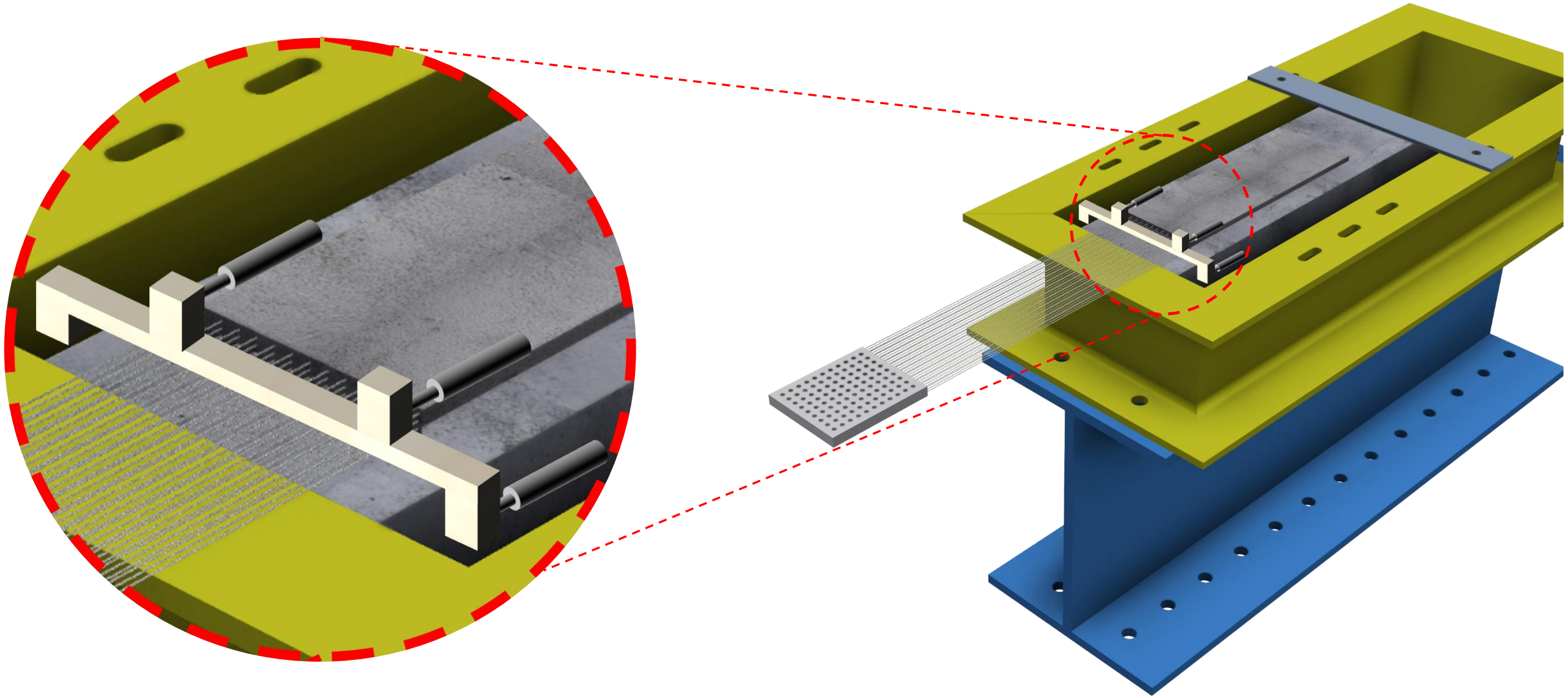
Dimensions



Alotaibi et al (2019)

Setup & Instrumentation

EXPERIMENTAL PROGRAMME



Alotaibi et al (2019)

EXPERIMENTAL PROGRAMME

- Concrete cubes

Compressive strength 14 MPa

- Steel fabric

Tensile strength 2800 MPa

Ultimate strain 1.5%

- Mortar prisms

Compressive strength 60 MPa

Flexural strength 8 MPa

RESULTS & DISCUSSION

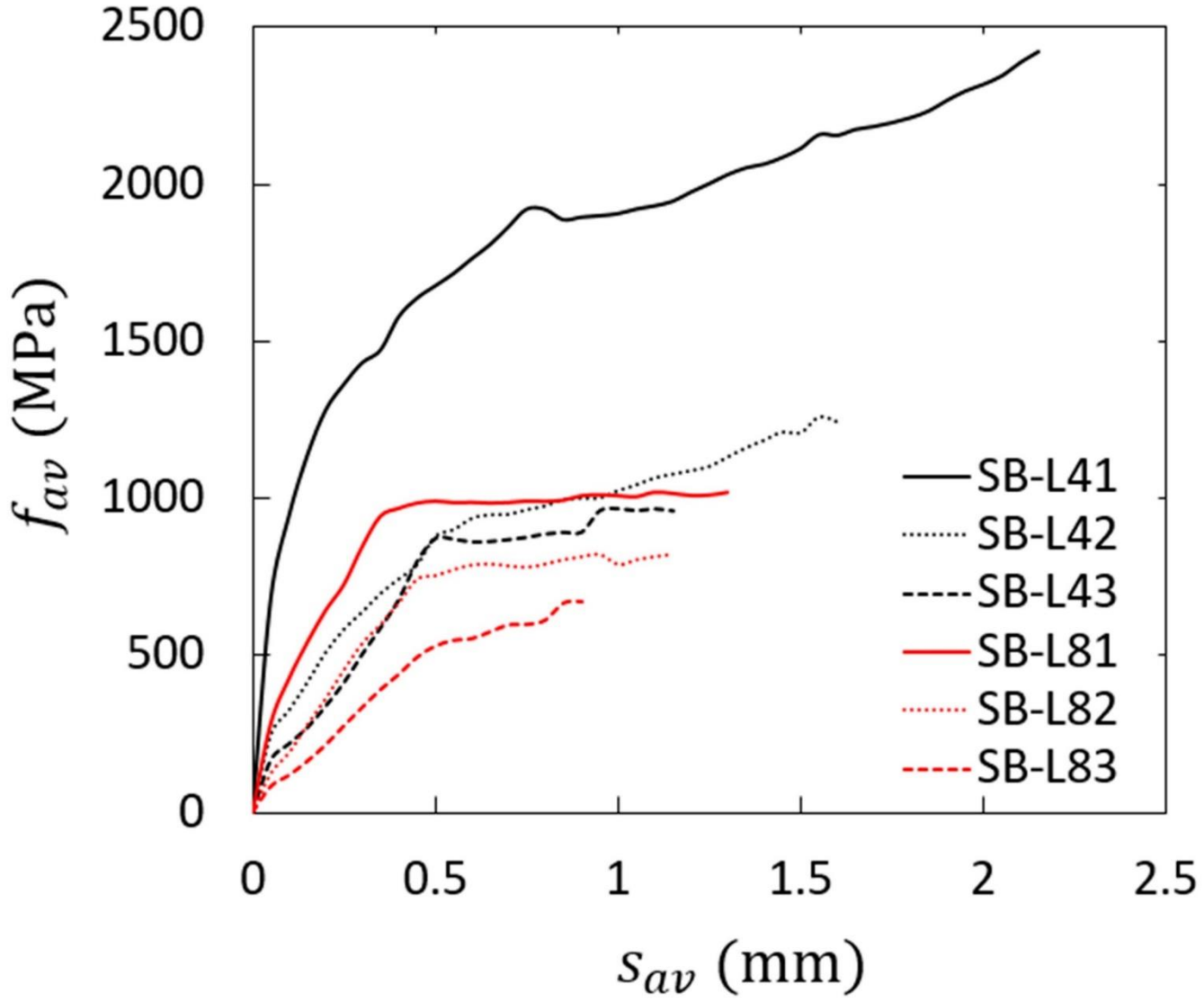
- $Number\ of\ layers \propto \frac{1}{Stress\ in\ cords}$
- $Number\ of\ layers \propto \frac{1}{Slip\ of\ composite}$

Series	P_{av} [kN]	f_{av} [MPa]	↓ [%]	s_{av} [mm]	↓ [%]
SB-L41	20.0	2473	--	2.13	--
SB-L42	20.3	1257	49	1.59	25
SB-L43	22.5	927	63	1.18	45
SB-L81	16.7	1030	--	1.3	--
SB-L82	27.7	857	17	1.15	12
SB-L83	30.6	631	39	0.92	29

Stress-Slip Curve

RESULTS & DISCUSSION

- Reduction in stress is more noticeable for higher-density fabric specimens
- Reduction in slip seems to have the same proportion for both fabrics



Alotaibi et al (2019)

Mode of Failure

Three failure modes were identified, including

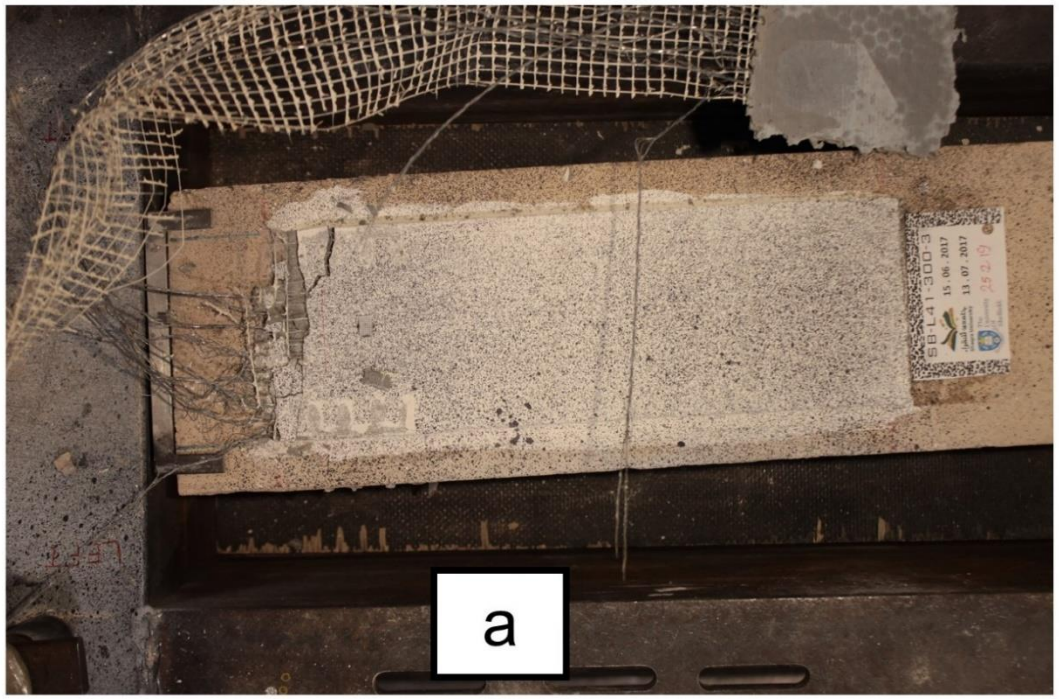
- rupture of the cords (1 layer of low-density fabric)
- interlaminar shear at the level of the fabric (1 layer of high-density fabric)
- substrate-composite interface debonding (2 and 3 layers of both steel fabrics)

Mode of Failure

RESULTS & DISCUSSION

- Failure by fabric rupture was achieved as the cords were loaded up to their ultimate strain

1 layer of 4 cord/in steel fabric

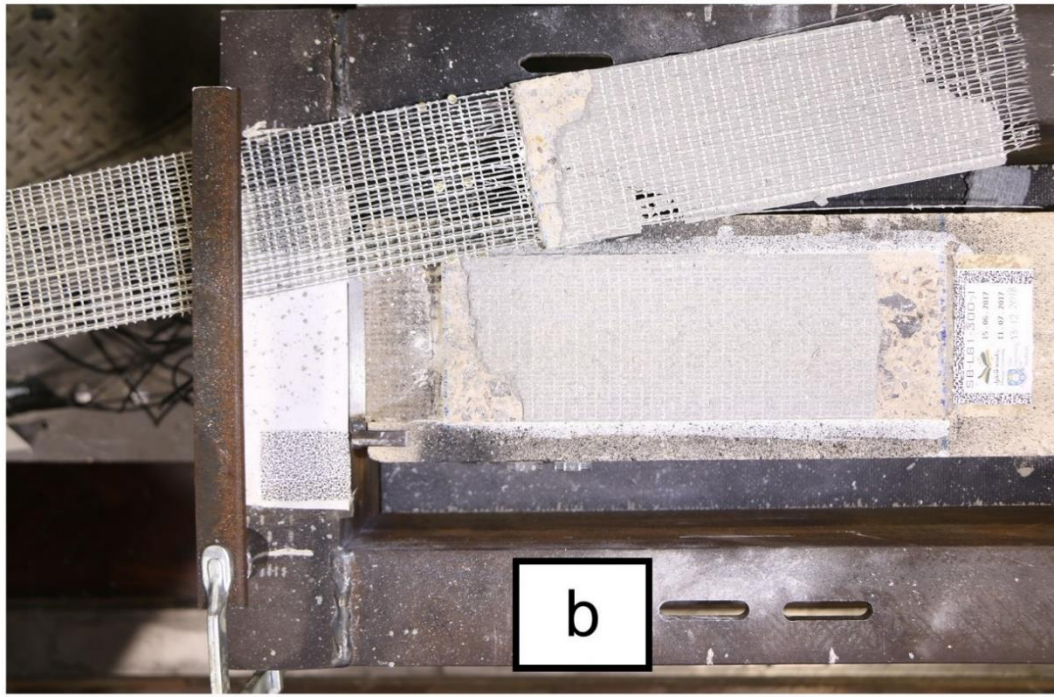


Rupture of steel cords outside the composite

Mode of Failure

- Failure by interlaminar shear was a result of high localised stresses due to higher cords density

1 layer of 8 cord/in steel fabric



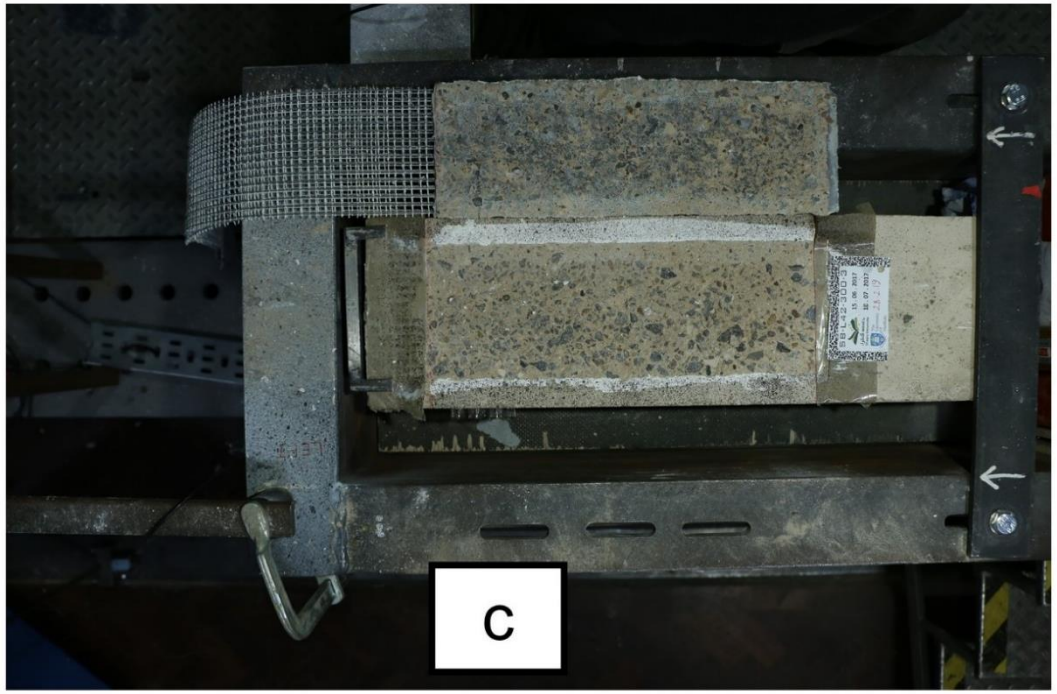
Detachment at fabric-to-matrix interface

Mode of Failure

RESULTS & DISCUSSION

- The use of multiple layers can lead to a more uniform distribution of stresses within the composite and promote debonding at the substrate-composite interface.

2& 3 layers (both steel fabrics)



Detachment at composite-to-substrate interface

Alotaibi et al (2019)

KEY FINDINGS

- Increasing the number of steel fabric layers leads to a decrease in the stress in the steel cords, as well as the slip of the composite, at failure

- Three failure modes were identified, including rupture of the cords, interlaminar shear at the level of the fabric, and substrate-composite interface debonding

Thank you

وزارة التعليم
Ministry of Education

KERAKOLL
The GreenBuilding Company

الملحقية الثقافية السعودية في المملكة المتحدة
Saudi Arabian Cultural Bureau in the UK