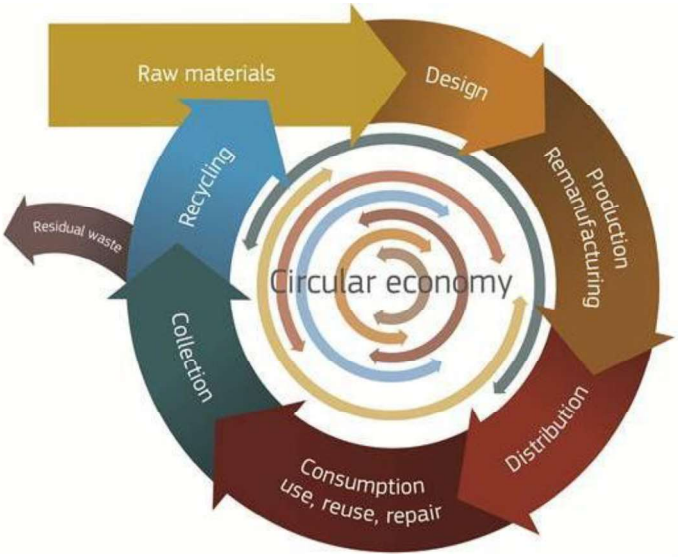
Nieuwe mogelijkheden met gerecycleerde granulaten

Prof. Dr.-Ing.Jiabin Li
Ing. Zeger Sierens
Ir. Brecht Vandevyvere

12/03/2019

Background & motivation



Background & motivation

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Background & motivation

- Recycling of concrete into aggregates $\neq$ new ideas
- Use of RCAs in concrete $\neq$ new research

Sub-foundation

C16/20

Road foundation

Ready-mix-concrete

C30/37

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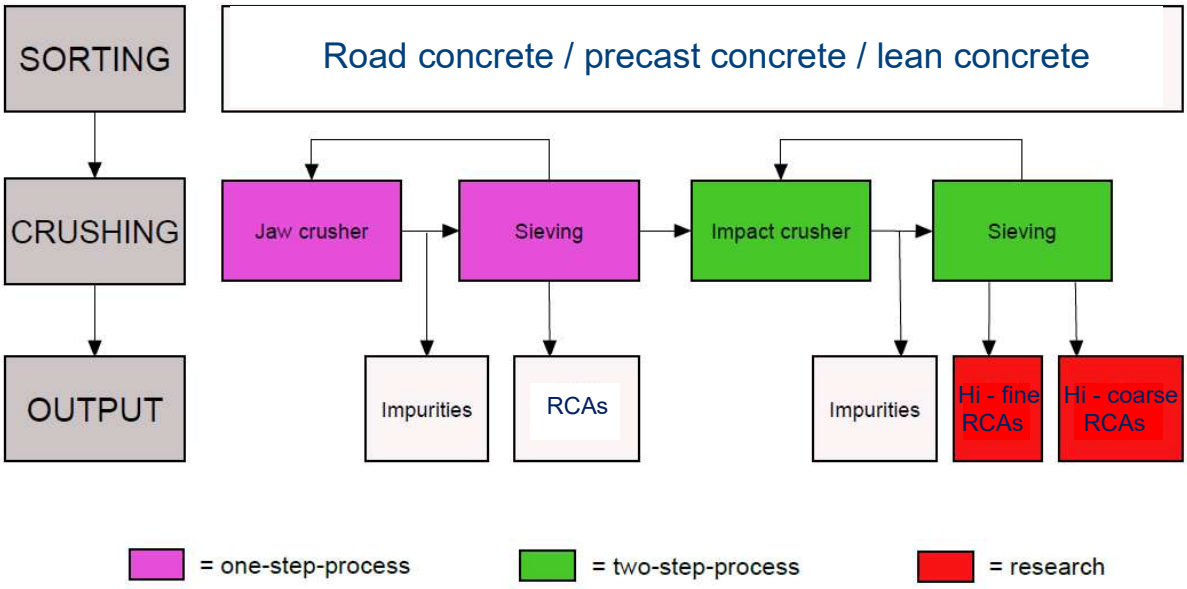
Background & motivation



High quality recycled concrete aggregates = HiRCAs

Use of HiRCAs in structural concrete

- New possibilities with HiRCAs

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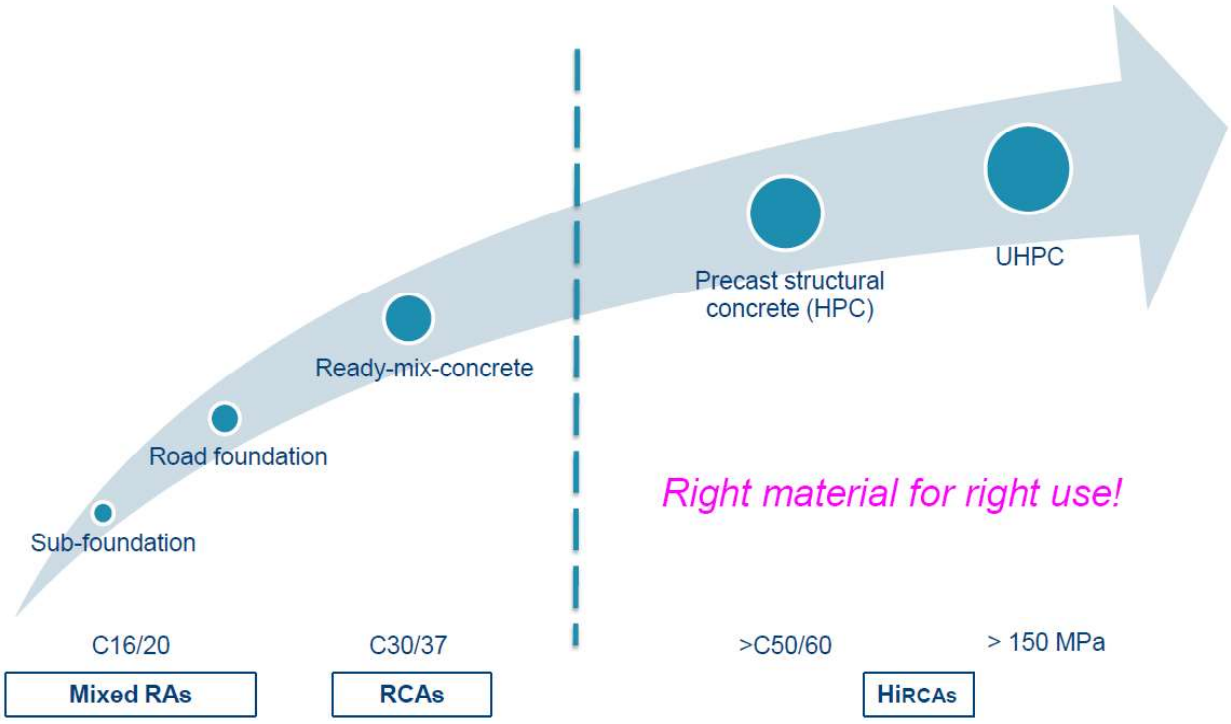
Research roadmap



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Use of HiRCAs in structural concrete

- Research line: use of HiRCAs for structural purpose
  - Precast structural concrete
  - Fibre reinforced concrete (FRC)
  - High- & Ultra high - performace concrete (HPC&UHPC)


Z. Sierens


B. Vandevyvere


X.Chen


S.Yuan


F.Yang


J.Cai

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Use of HiRCAs in structural concrete

Ongoing PhD/Post-doc projects:

- Use of RCAs in precast non-prestressed and prestressed structural elements (Z. Sierens)
- Structural use of concrete with RCAs – Fibre reinforced concrete with RCAs (B. Vandevyvere)
- High performance concrete (HPC) with RCAs for precast industry (X. Chen)
- Constitutive modelling and finite element analysis of concrete with RCAs (F. Yang)
- Ultra high performance concrete (UHPC) with RCAs (S. Yuan)
- Muliscale modelling of structural concrete with RCAs (J. Cai)

Ongoing research

Use of RCAs in precast structural concrete

- Research content
  - Mechanical properties of concrete with RCAs at early ages
  - Creep and shrinkage of concrete with RCAs
  - Bond – slip behaviour of reinforcement / prestressing strand
  - Camber of prestressed beams made of concrete with RCAs

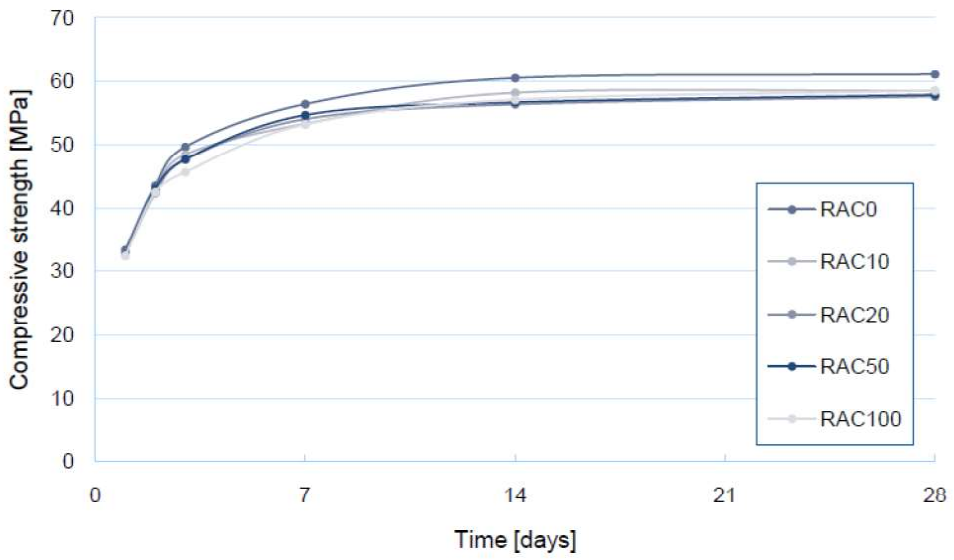
Ongoing research

Use of RCAs in precast structural concrete

	RAC0	RAC10	RAC20	RAC50	RAC100
CEM I 52.5R (kg/m³)	400	400	400	400	400
W/C_{eff}	0.48	0.48	0.48	0.48	0.48
Sand 0/4 (kg/m³)	780	780	780	780	780
Limestone 2-6.3mm (kg/m³)	196	196	196	196	196
Limestone 6.3-14mm (kg/m³)	785	706	628	392	0
RCA 6.3-14 (kg/m³)	0	74	148	371	742
Superplasticizer (kg/m³)	1.3	1.3	1.3	1.3	1.3
Compensation water (kg/m³)	7	10	13	22	38
Slump (mm)	210	197	195	192	190

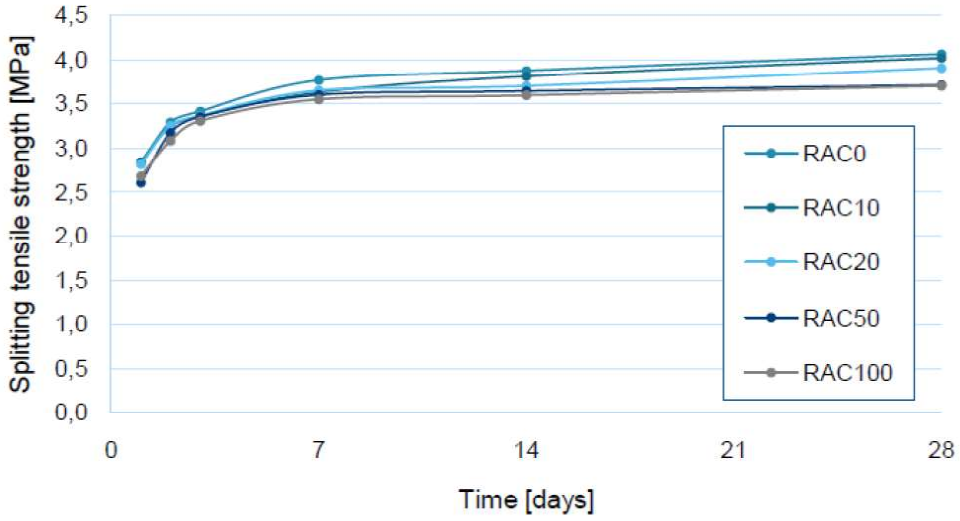
Ongoing research

Project 1: Use of RCAs in precast structural concrete



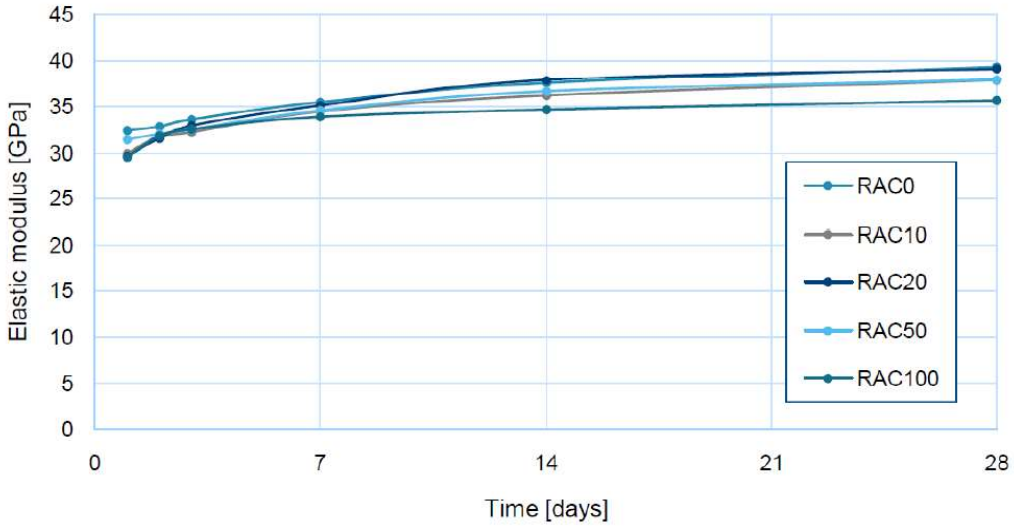
Ongoing research

Project 1: Use of RCAs in precast structural concrete



Ongoing research

Project 1: Use of RCAs in precast structural concrete



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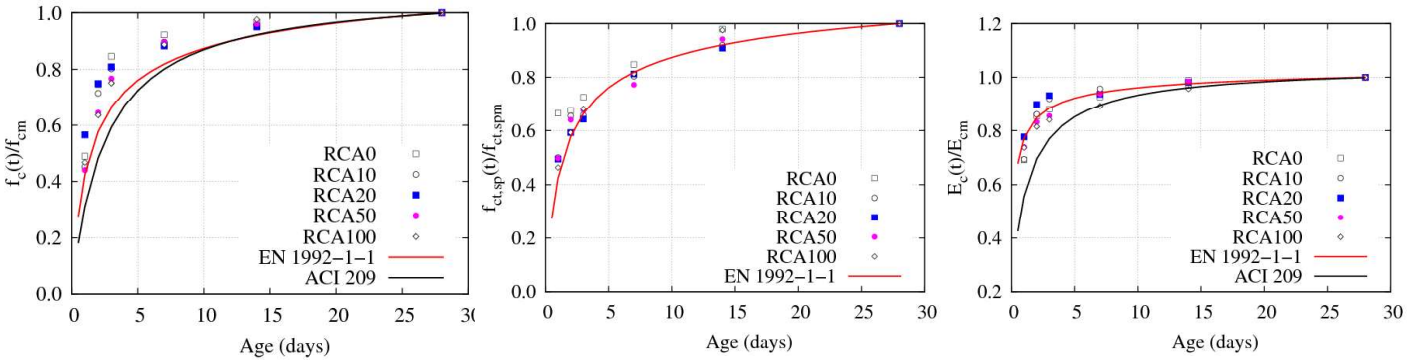
Ongoing research

Project 1: Use of RCAs in precast structural concrete



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Ongoing research

Project 2: Structural use of RCAs – fibre reinforced concrete with RCAs

- Research content
  - Influence of various types of fibres on concrete with RCAs
  - Modelling of fibre reinforced concrete with RCAs
  - Design of fibre reinforced concrete with RCAs

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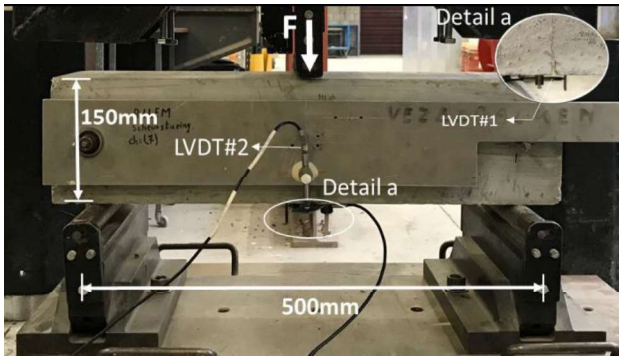
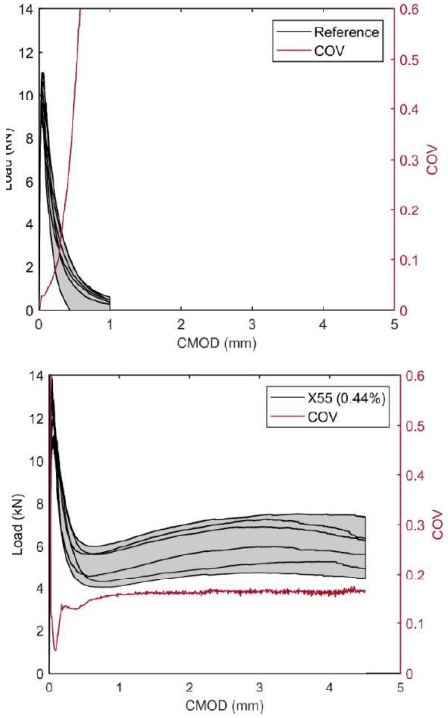
Ongoing research

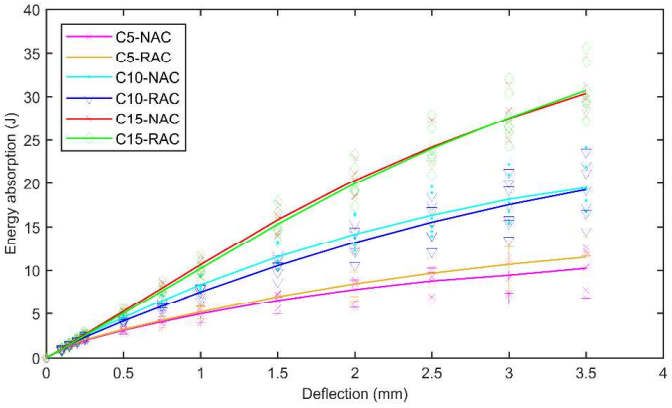
Project 2: Structural use of RCAs – fibre reinforced concrete with RCAs





Ongoing research

Project 2: Structural use of RCAs – fibre reinforced concrete with RCAs



Ongoing research

Project 3: UHPC with HiRCAs

RCA (4-8mm)

Basalt (4-8mm)

Ongoing research

Project 3: UHPC with HiRCAs

- UHPC-NA-8mm-0,5%
  - 12,3 $\%_{V/V}$ basalt 4-8mm
  - 0,5 % fibers
- UHPC-RCA-8mm-0,5%-WA0
  - 12,3 $\%_{V/V}$ RCA 4-8mm
  - 0,5 % fibers
- UHPC-RCA-8mm-0,5%-WA50
  - 12,3 $\%_{V/V}$ RCA 4-8mm
  - 0,5% fibers
- UHPC-RCA-8mm-0,5%-WA100
  - 12,3 $\%_{V/V}$ RCA 4-8mm
  - 0,5 % fibers

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Ongoing research

Project 3: UHPC with HiRCAs

Ongoing research

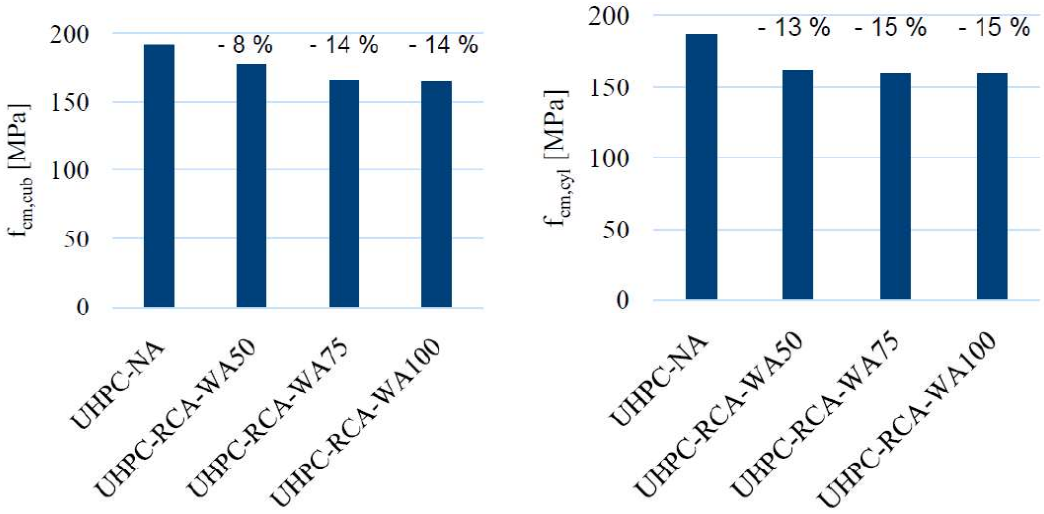
Project 3: UHPC with HiRCAs

Table 10 - Workability of concrete mixtures

Mixture	t_{200} [s]	d_m [mm]
UHPC-NA	16	257
UHPC-RCA-WA50	15	249
UHPC-RCA-WA75	9	278
UHPC-RCA-WA100	8	275

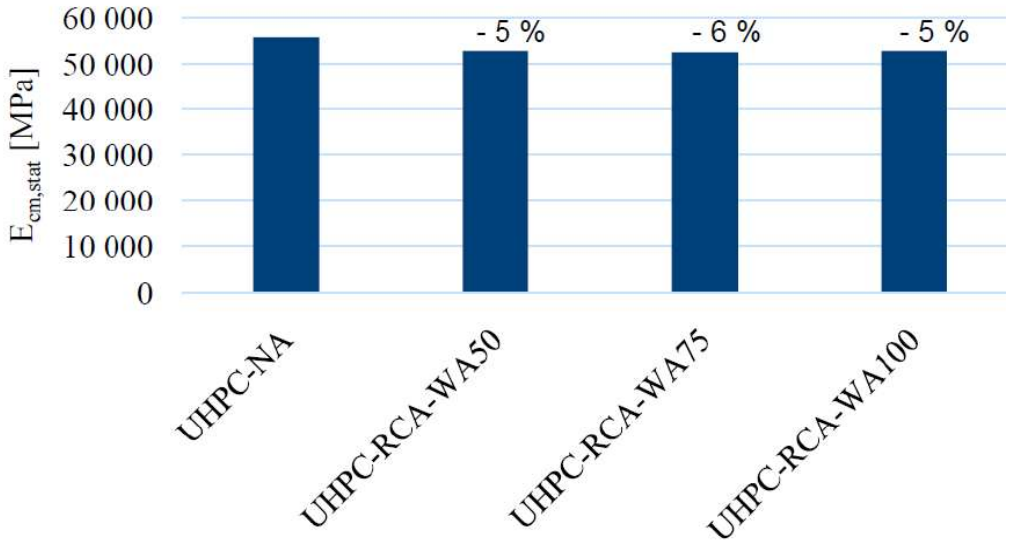
Ongoing research

Project 3: UHPC with HiRCAs



Ongoing research

Project 3: UHPC with HiRCAs



Ongoing research

Project 3: UHPC with HiRCAs

Table 11 Flexural tensile strength

Mixture	Flexural tensile strength [MPa]	Mean value [MPa]
UHPC-NA beam 1	12.20	
UHPC-NA beam 2	11.61	11.48
UHPC-NA beam 3	10.65	
UHPC-RCA-WA50 beam 1	9.70	9.99
UHPC-RCA-WA50 beam 2	10.28	

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Short CV

- 02/1978 Born in Hebei, China
- 07/2004 Master in Civil Engineering, Tongji Univ., Shanghai, China
- 04/2011 PhD (Dr.-Ing) in Civil Engineering, Univ. of Leipzig,Germany

- 2005 – 2009 Research assistant, Univ. of Leipzig, Germany
- 2010 – 2016 Senior researcher, TU Graz, Austria
- 2016 – 2016 Associate Professor, Oslo Univ. Colle, Norway
- 10/2016 - Assistant Professor in Civil Engineering, KU Leuven
- 06/2017 - Holder, Han & Li Chair in Smart & Sustainable Infrastructure, KU Leuven
- 07/2018 - Holder, Lvnong Chair in Construction Waste Recycling KU Leuven

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Acknowledgements

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Thank you very much for your kind attention!

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