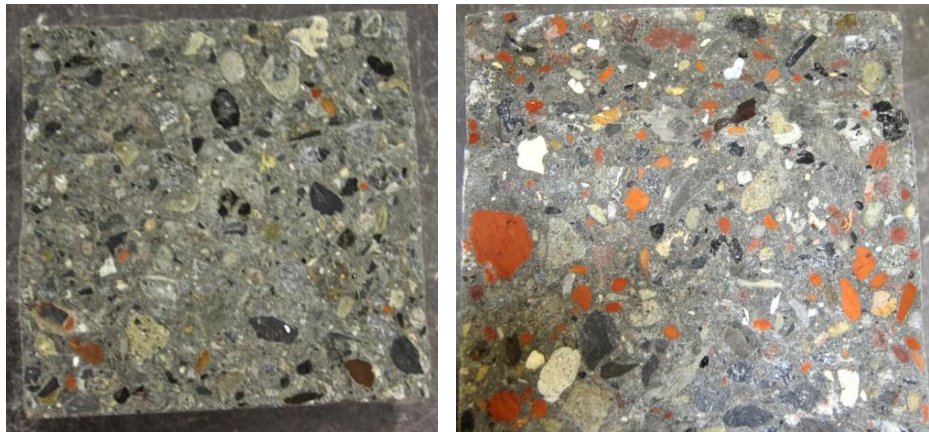




SeRaMCo

Development of new concrete mixes from recycled aggregates from unknown origin

Anja Tusch

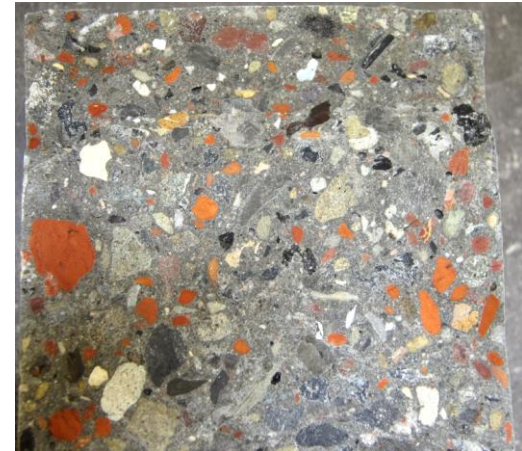


Development of different new concrete mixes containing recycled aggregates from unknown origin

Recycled aggregates



Concrete



Production of concrete containing recycled aggregates from unknown origin causes some challenges:



Aggregates

- Great variety of the materials
- Great variety of the properties



Fresh concrete

- Workability due to the higher waterabsorption



Hardened concrete

- Strength
- Deformation behaviour
- Durability

Mixture for the production of structural elements

Mixture for the production of non-structural elements

Rammed concrete

Salty concrete



Crushed concrete

Type A (except R_a)

WA24: 4–5 wt.-%

Density: 2.3 kg/dm³

Fractions: 2-6 mm, 6-14 mm, 14-22 mm



Mixed aggregates

Type B (except R_a)

WA24: 6-9 wt.-%

Density: 2.2 kg/dm³

Fractions: 2-6 mm, 6-14 mm, 14-22 mm

Mixture for the production of structural elements

Mixture for the production of non-structural elements/ Pavement

Starting point: Development of a concrete mixture, which can be used for different structural elements

Challenge: The products are not known yet and the mixture has to be very variably

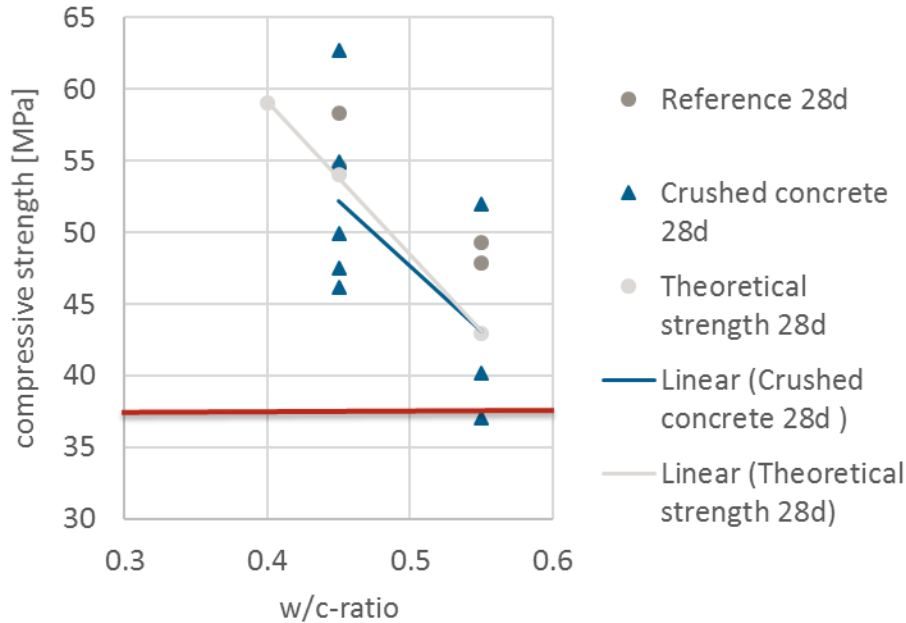
Planned test procedure:

- Design a mixture which is able to match C 30/37 by using a standard CEM I 42.5 and recycled aggregates
- Using two different w/c ratios for the concreting of the mixture → w/c: 0.45; 0.55
- Verify the results by using different cements → CEM II 42.5; CEM I 52.5

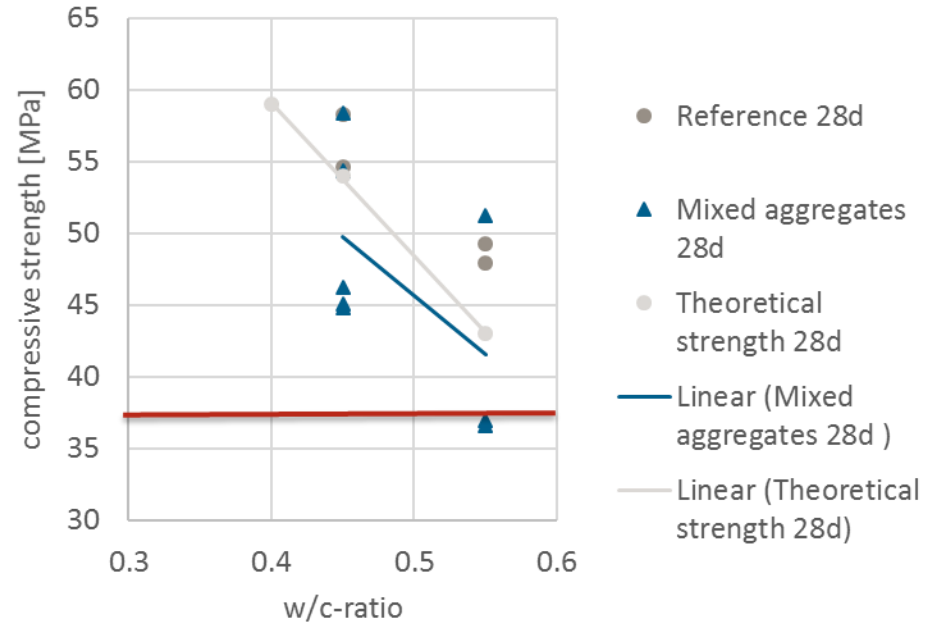


Results test series 1:

Crushed concrete aggregates

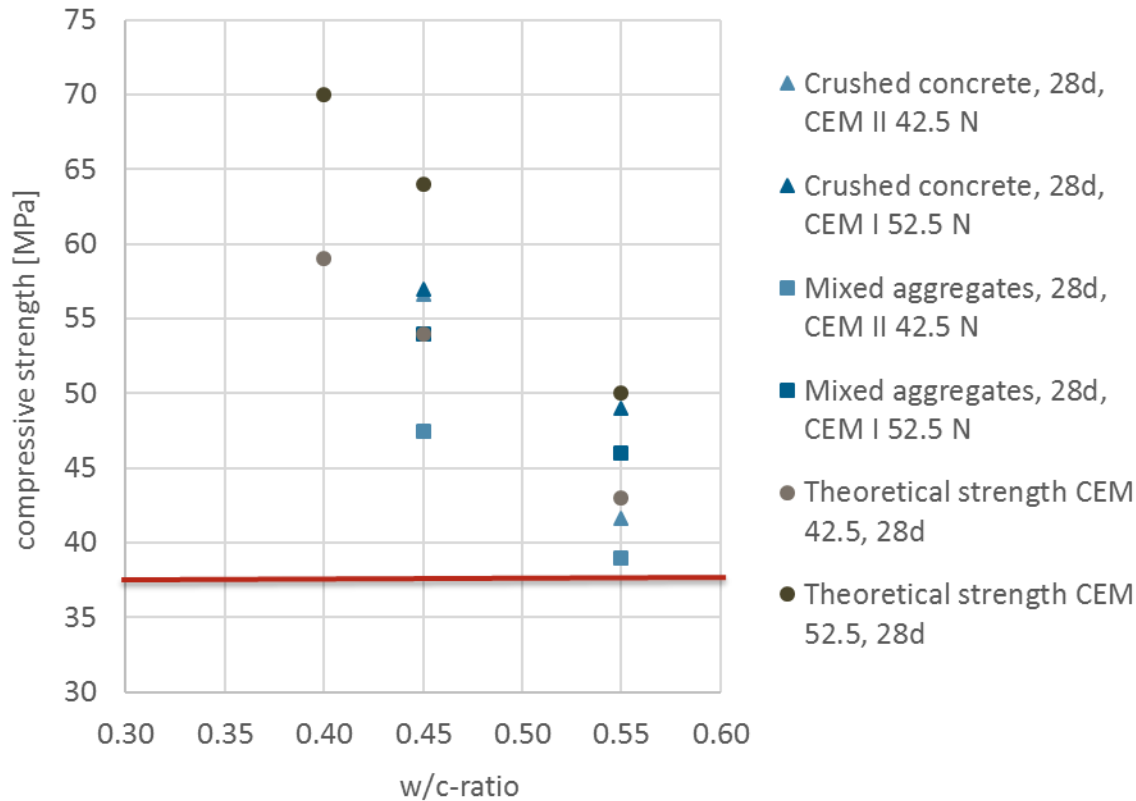


Mixed aggregates



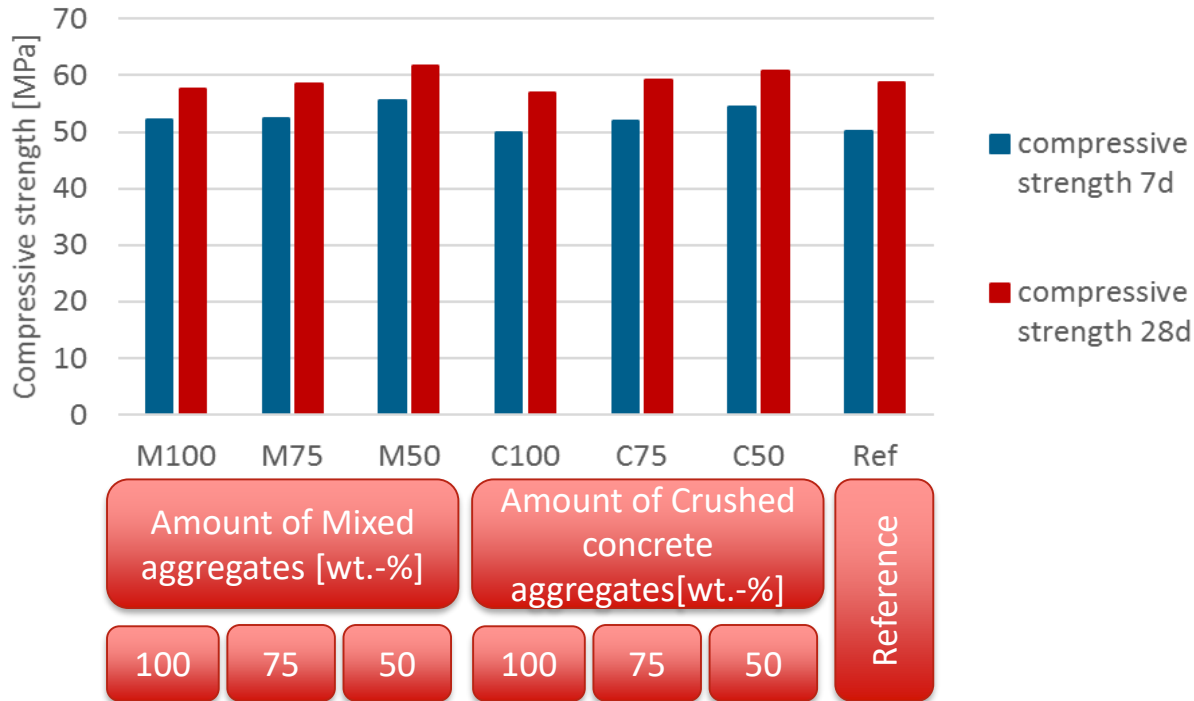
The variations of the w/c ratio results in a scattering of the compressive strength

Results test series 2:



The results of
test series 1
were confirmed
by test series 2

Results test series 3:



Reducing the amount of recycled aggregates improves the compressive strength to a small extent, but in sum all results are ranging in the same area as the reference

Mixture for the production of structural elements

Mixture for the production of non-structural elements/ Pavement

Requirements:

- Slump 0 (earth-moist concrete)
- High early age strength
- The resulting concrete has to fulfill the standards of EN 1338

Challenge: Properties of the product depend on the mixture as well as on the used process technology



Development of the concrete mix for non-structural elements / paving blocks

Test procedure:

Step 1

- Determination of a well graded grain composition with a suitable cement amount and an optimum water content
- Analogous to the determination of the proctor density

Step 2

- Determine the properties of the resulting concrete mixture
- Is it able to fulfill the requirements?

Step 3

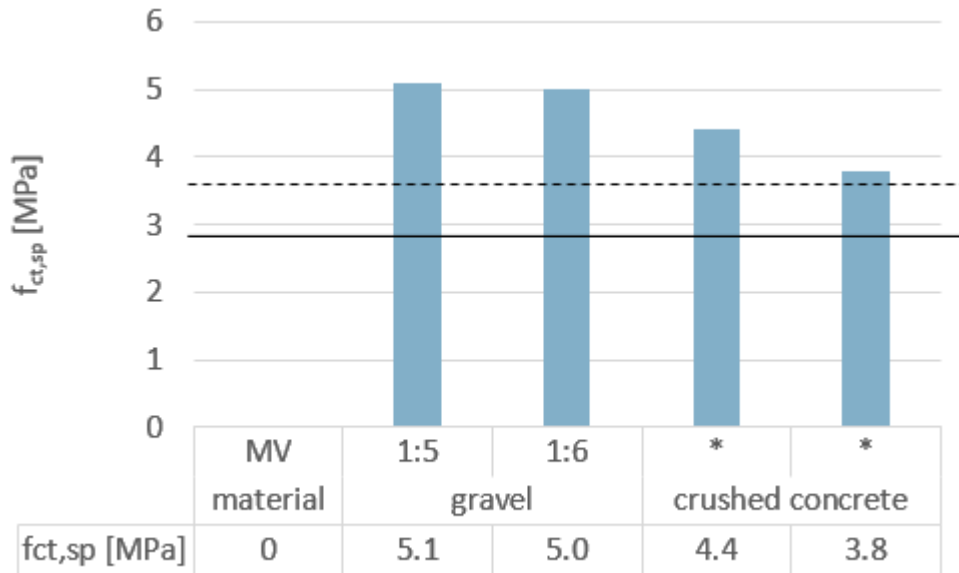
- Optimization if needed
- Addition of additives if needed

Step 4

- Testing the mixture directly in the production line
- Optimization of the mixture in combination with the production process



Results



Procedure to find a suitable mixture:

- Selection of aggregates
- Determination of average cement content (corresponds to mixing ratio)
- Determination of the optimum water content in the test
- Preparation of samples and determination of strength (applying strength by cement content)
- Calculation of the mixture composition from the ingredients

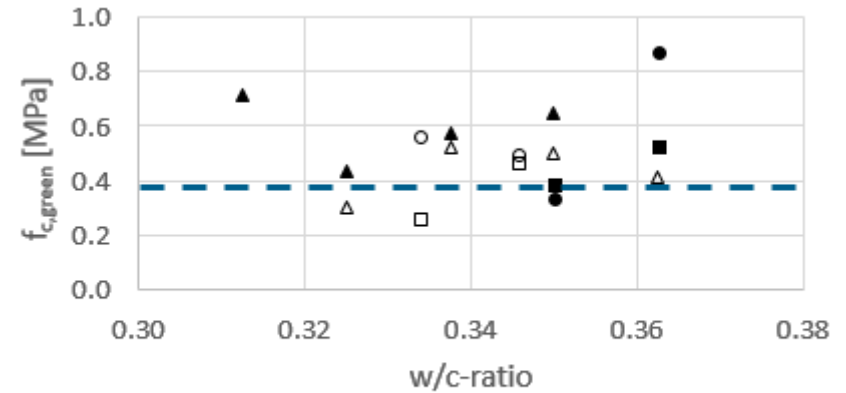
Results green strength

Parameter	Influence
Water content	Most important (optimum = w_{opt})
Concrete composition (cement content and specific surface!)	Increasing with increasing cement content and specific surface
Grading curve of aggregates	Minor influence
Admixtures/additives	Depends on individual case (mixing ratio, added amount)
Compaction energy	Important

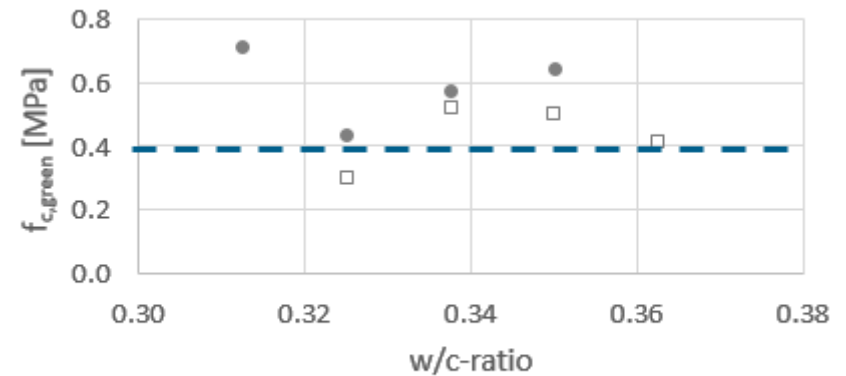


Results green strength

Mix	Mixing ratio	W	C	FA	QP	Aggregates
1	1:6	x	x	0	0	Gravel
2	1:5	x	x	0	0	Crushed concrete
3	1:6	x	x	0	0	Gravel
4	1:5	x	x	0	0	Crushed concrete
5	1:5	x	x	x	0	Gravel
6	1:5	x	x	0	x	Gravel
7	1:5	x	x	x	0	Gravel
8	1:5	x	x	0	x	Gravel
9	1:5	x	x	x	0	Crushed concrete
10	1:5	x	x	0	x	Crushed concrete



□ M7/G, FA ○ M9/R, FA △ M2/G ■ M8/G, QP ● M10/R, QP ▲ M4/R



□ M2, G ● M4, RC

Thank you for your attention!