



Healthier Life with Eco-innovative Components for Housing Constructions

Multifunctional components for the building envelope

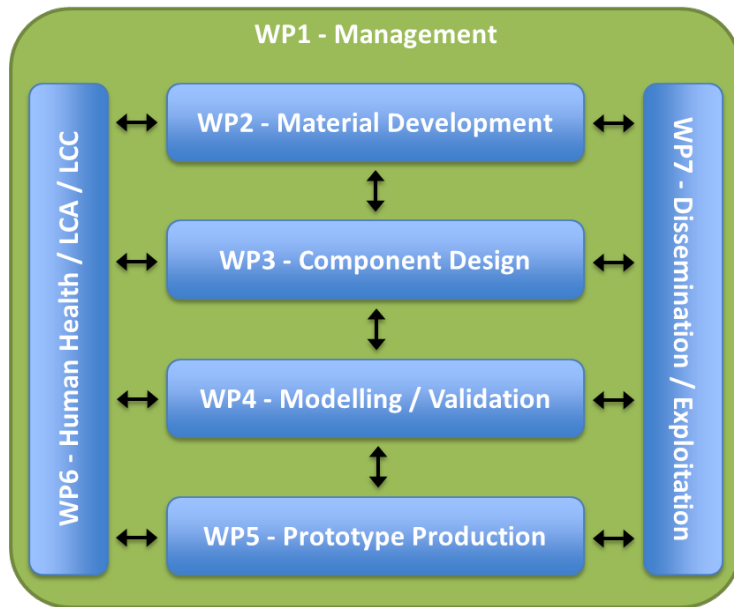
Nelson Silva, CBI



Content

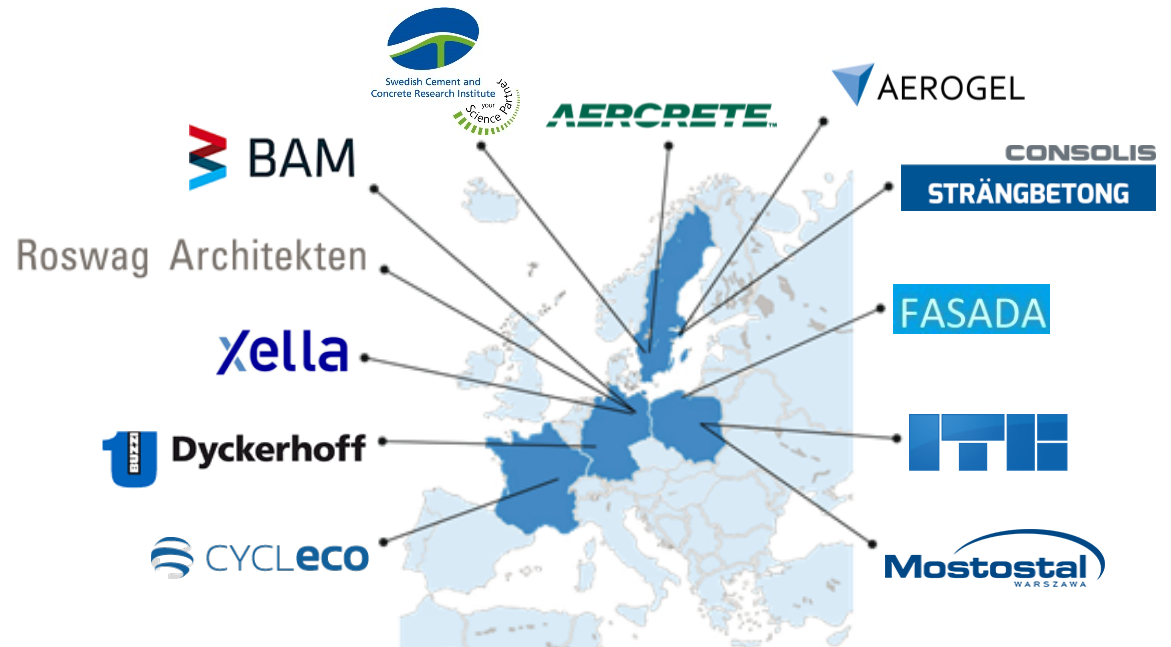
- Overview, Goals and Concept
- Material Development
- Component Development

Project Overview



- 4 years (Sep'13 – Aug'17)
- 6.55 M€ (4.75 M€ from EC)
- **25% RTD 42% SME 33% IND**

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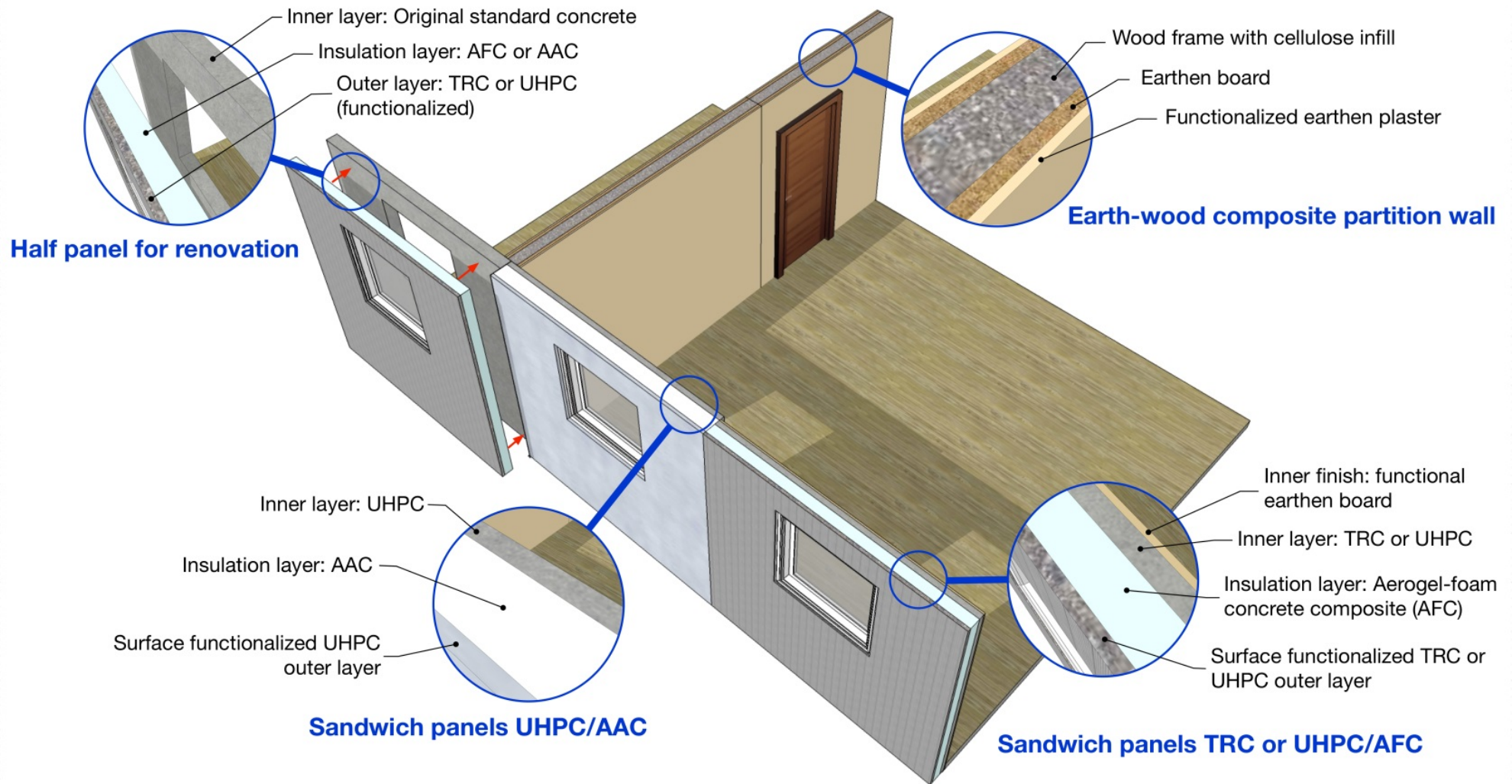


Project Goals

Development of building materials and components for external and internal walls, for both new buildings and renovation.

- Physical and chemical properties
- Indoor air quality
- Energy efficiency and sound insulation
- Embodied energy
- Durability, maintenance and service life

Project Concept



Textile Reinforced Concrete (TRC)



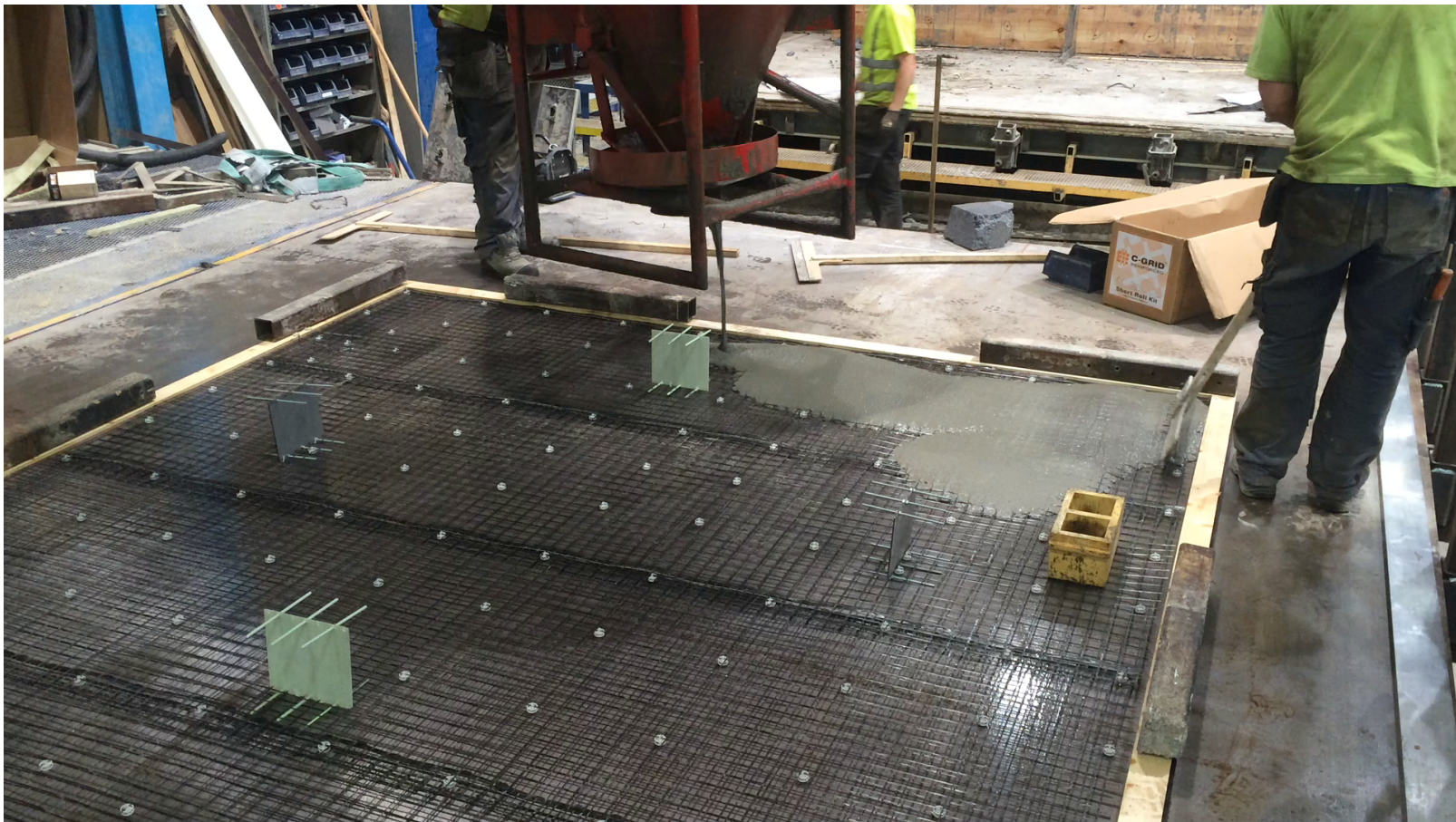
- 80-100 MPa
- Carbon grid reinforcement
- Functionalized surfaces (TiO_2)

- Improved durability: no corrosion, frost-resistant and easy-to-clean surfaces
- Reduced embodied energy: no steel reinforcement, low clinker content, reduced thickness / lightweight



Textile Reinforced Concrete (TRC)

Scale-up production



Textile Reinforced Concrete (TRC)

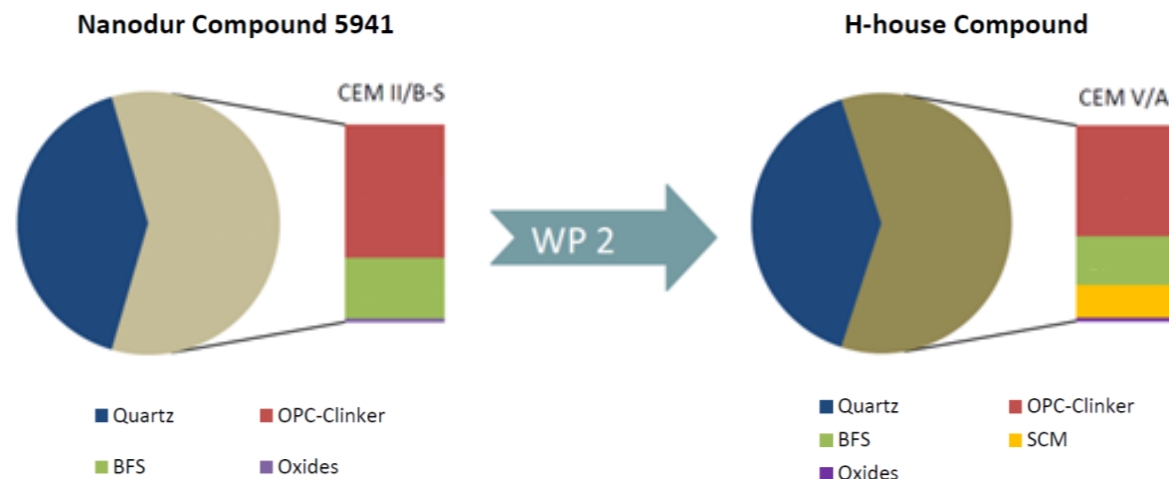
Scale-up production



Ultra High Performance Concrete (UHPC)

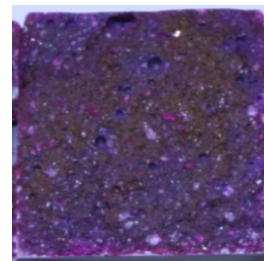


- Reduced embodied energy



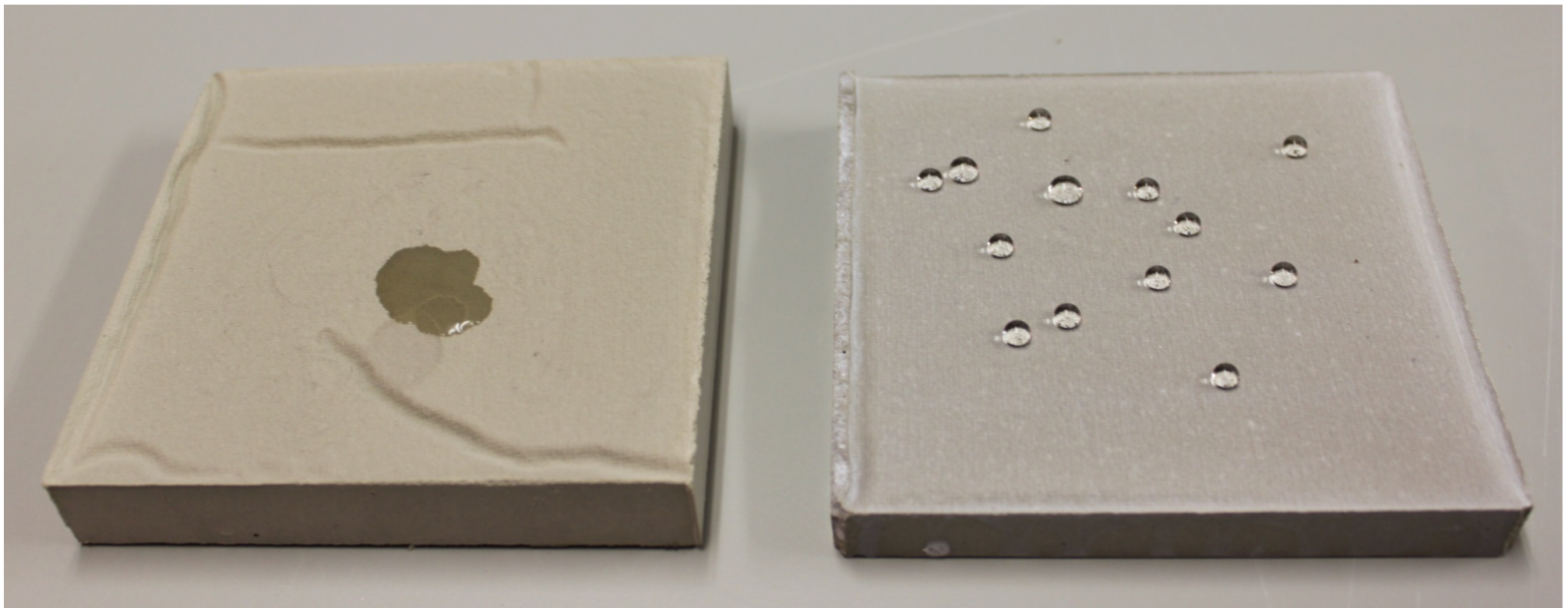
- 140 MPa
- No reinforcement
- Self-cleaning surfaces

- Improved durability



Ultra High Performance Concrete (UHPC)

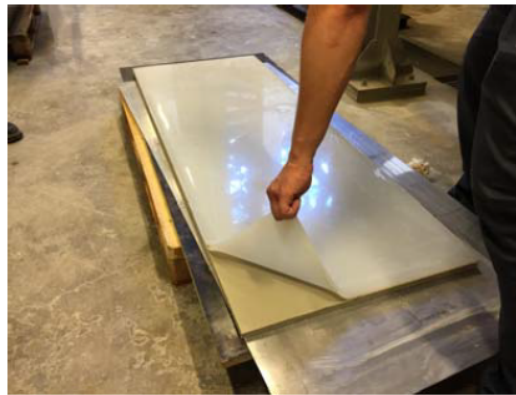
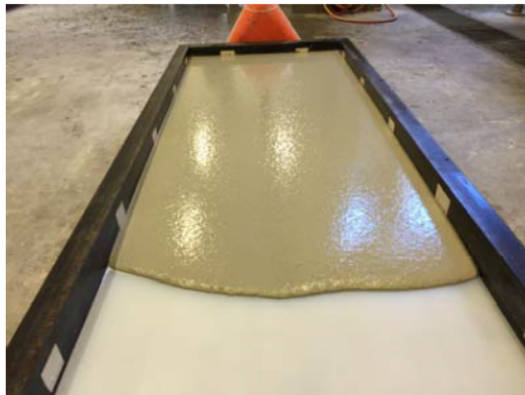
Self-cleaning superhydrophobic surfaces (Lotus effect)



- Contact angle $\geq 140^\circ$
- Roll-off angle $\leq 10^\circ$

Ultra High Performance Concrete (UHPC)

Scale-up production (pilot scale)



Foam Concrete (FC) + Aerogels

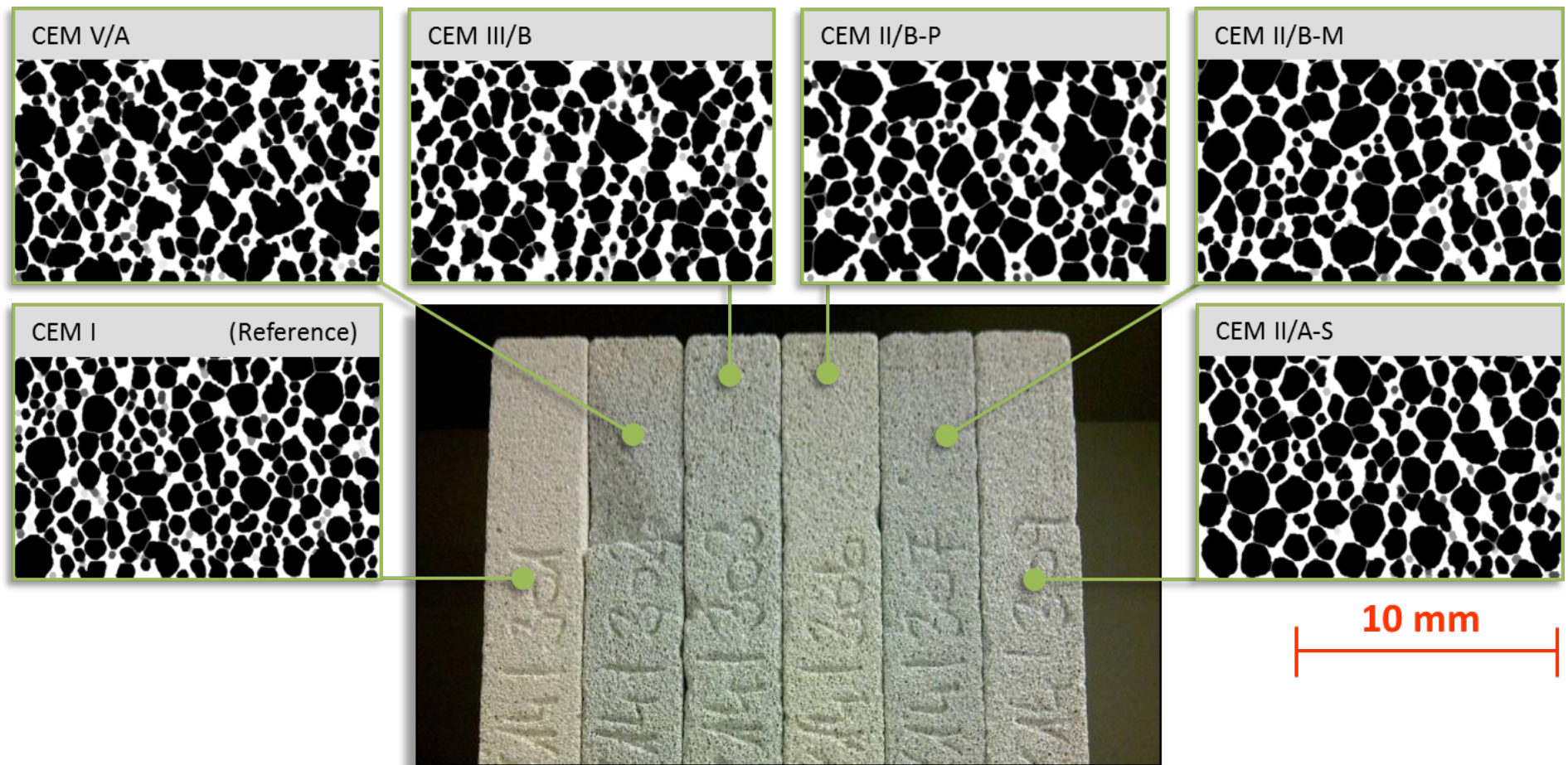


- 120 kg/m^3
- $40 \text{ mW/(m}\cdot\text{K)}$ wo. aerogel
- $30 \text{ mW/(m}\cdot\text{K)}$ wi. 30 vol.% aerogel

- Improved fire-safety: non-flammable and non-toxic
- Reduced embodied energy: low cement content and ambient pressure drying
- Energy efficient: good thermal performance

Autoclaved Aerated Concrete (AAC)

Optimization based on performance properties



Autoclaved Aerated Concrete (AAC)

Optimization based on LCA

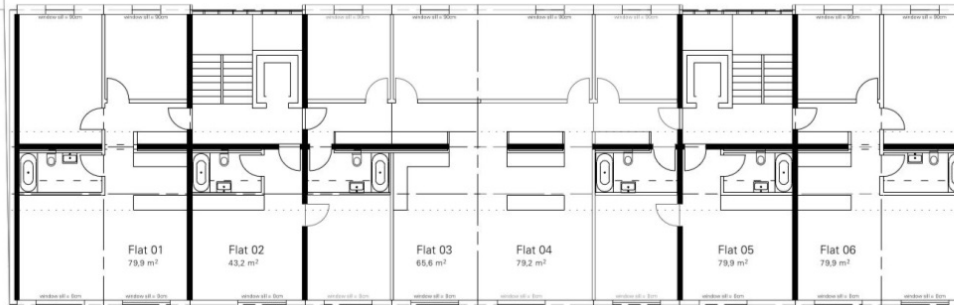
Impact category	REFERENCE CEM I 42,5 R(ft)	CEM II/A-S 52,5N	CEM II/B-P 42,5N	CEM II/B-M (V- LL) 42,5R	CEM III/A 42,5 N	CEM III/B 42,5 N	CEM V/A(S-P) 42,5 N
Non renewable energy [kwh]	0	3%	-2%	-5%	13%	19%	1%
Climate change [kg CO ₂ eq]	0	-3%	-5%	-9%	-3%	-5%	-11%
Acidification [molc H ⁺ eq]	0	-1%	-5%	-9%	3%	4%	-8%
Terrestrial eutrophication [molc N eq]	0	-3%	-7%	-10%	-5%	-8%	-13%
Freshwater eutrophication [kg P eq]	0	10%	-4%	-6%	19%	29%	5%
Freshwater ecotoxicity [CTUe]	0	3%	-2%	-3%	7%	11%	1%
Land use [kg C deficit]	0	3%	49%	-2%	15%	21%	56%

Conceptual design

Sample

Plan

VI



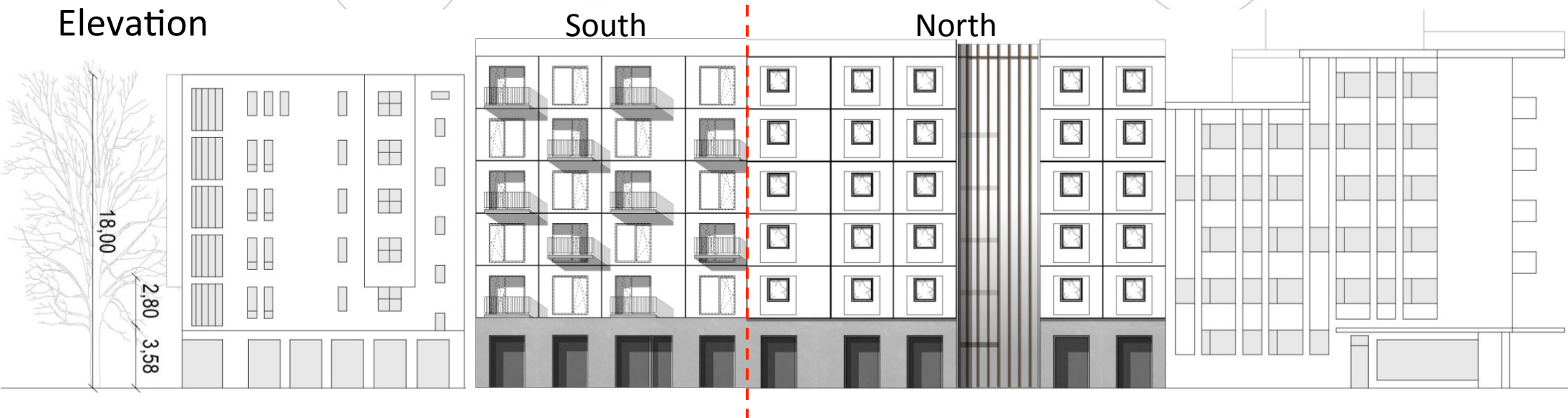
V

VI

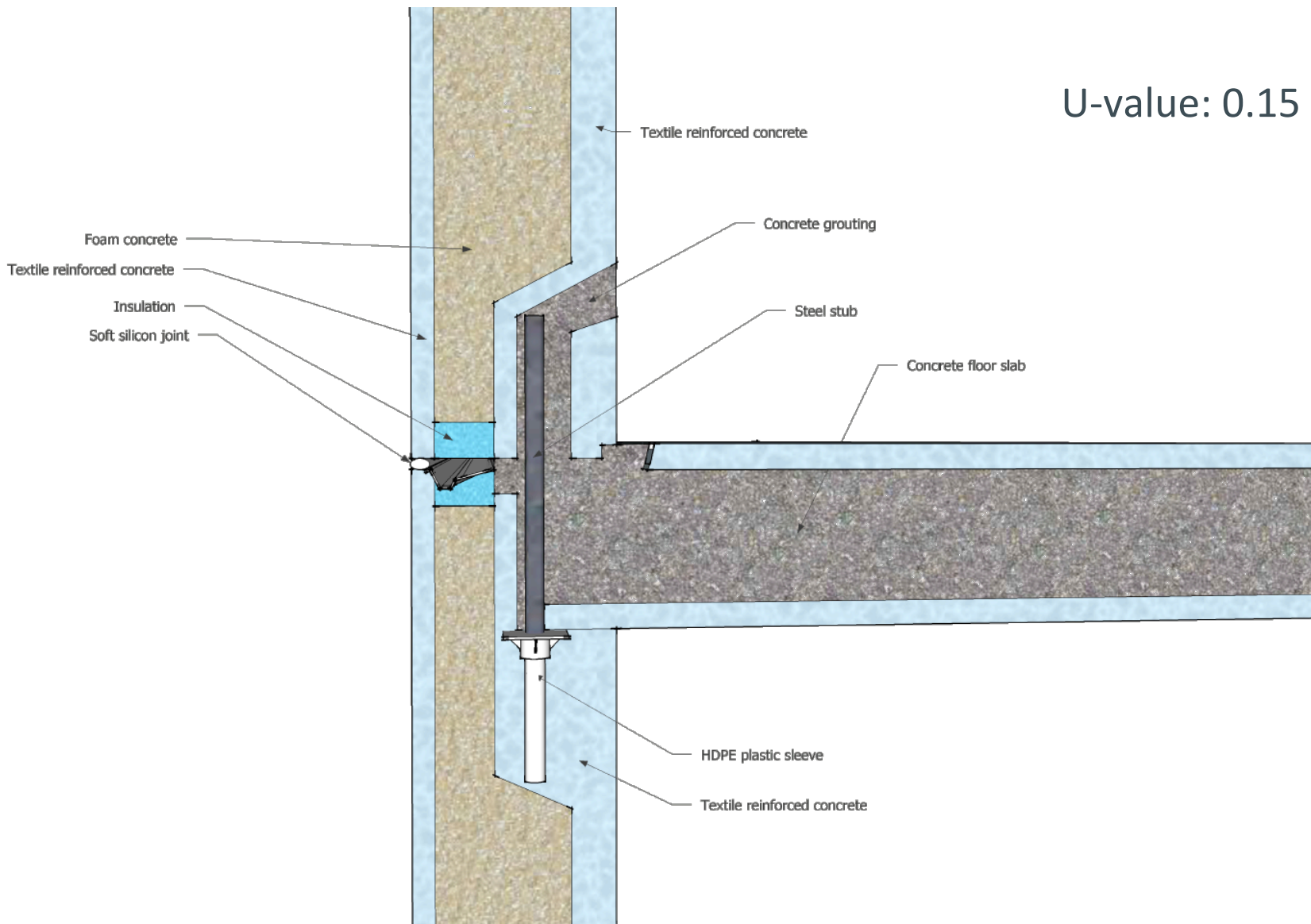
Elevation

South

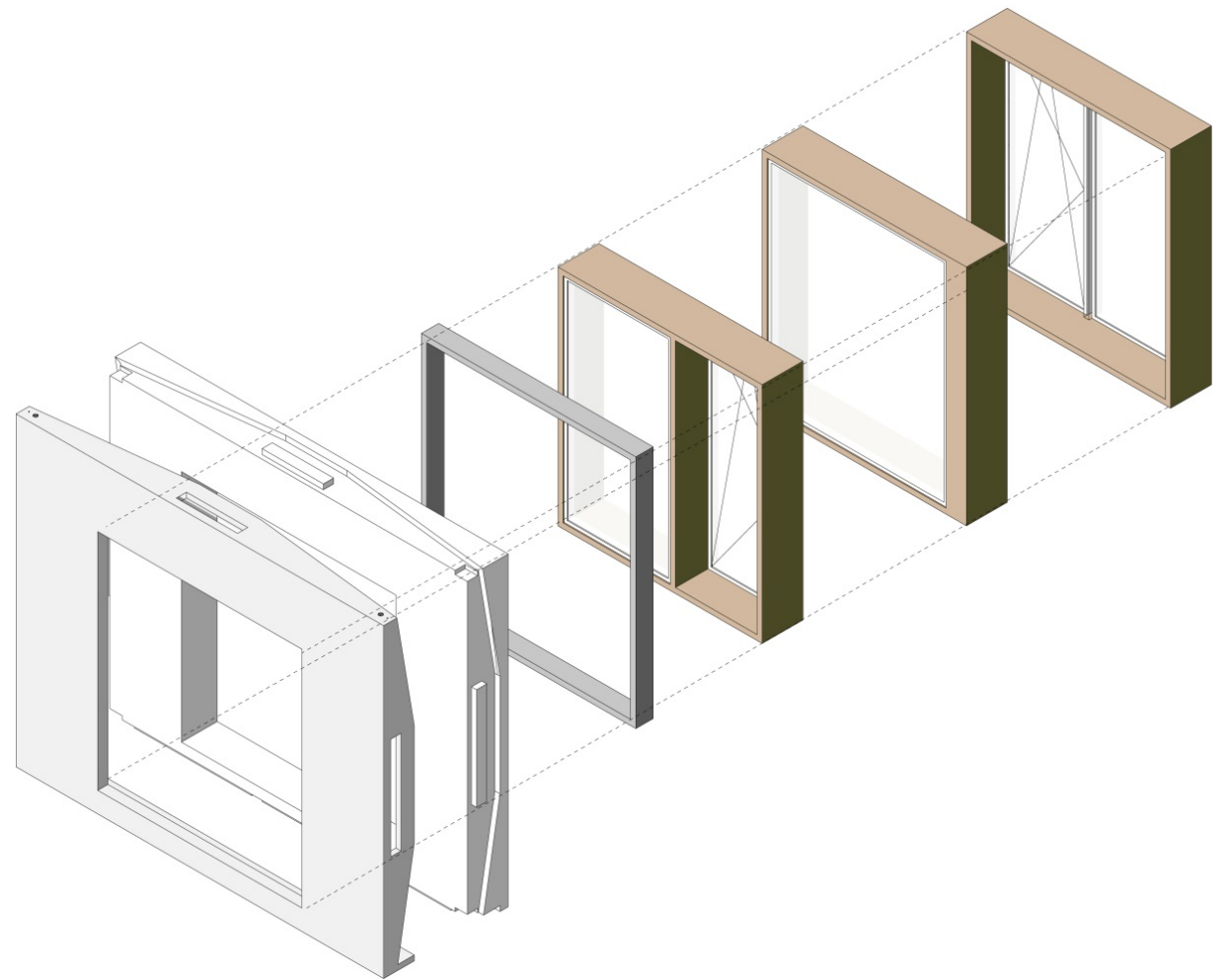
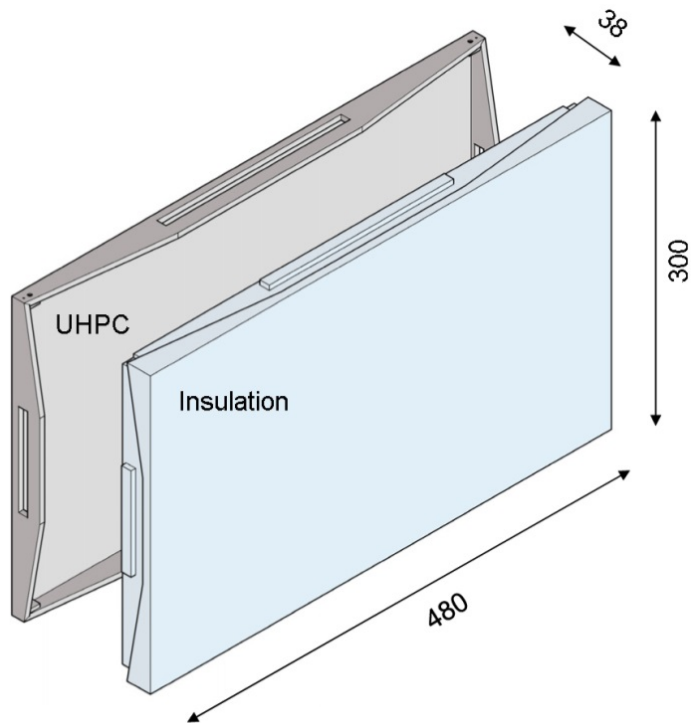
North



TRC-FC façade elements concept



UHPC-AAC façade elements concept



Acknowledgements



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Roswag Architekten

