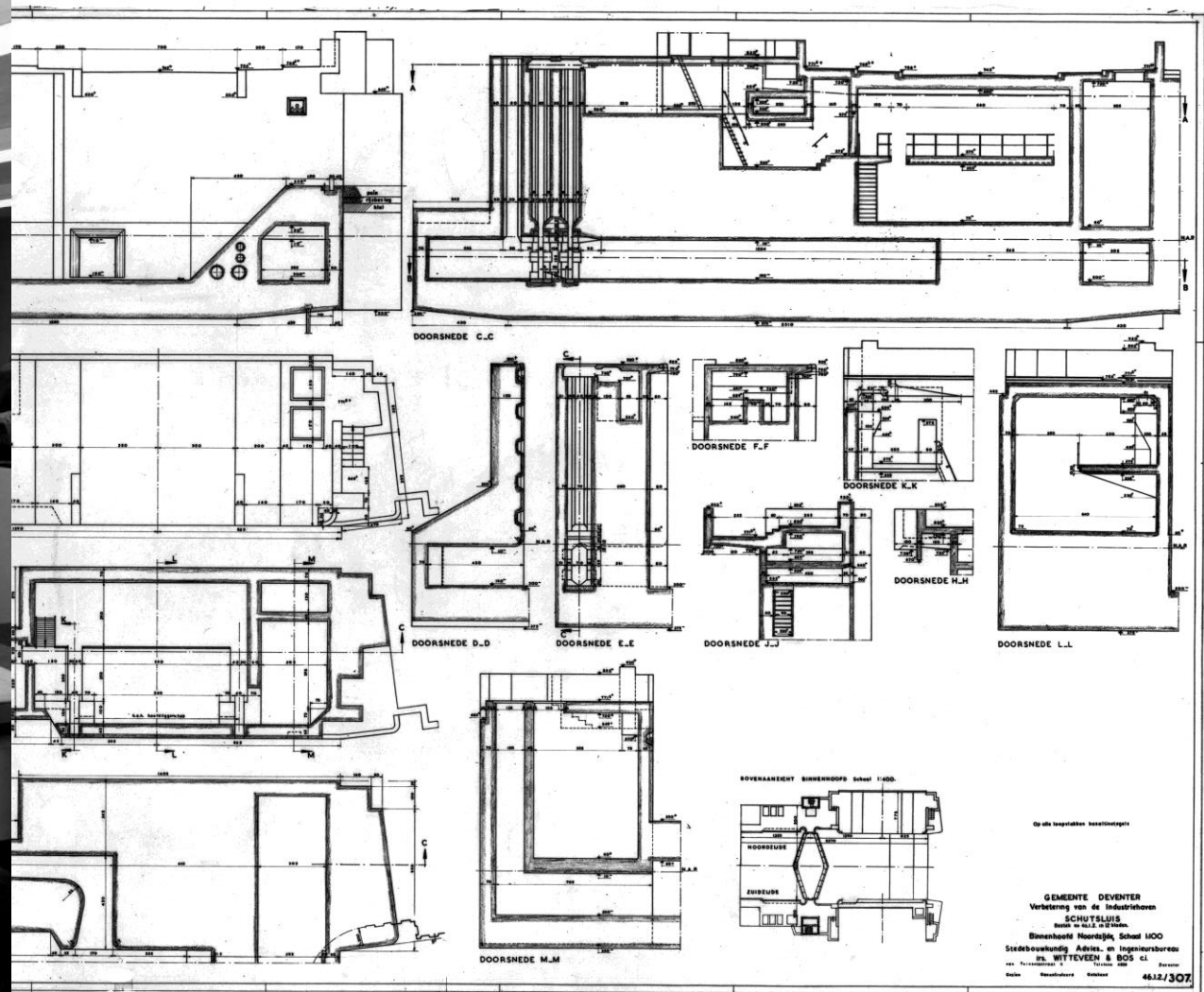


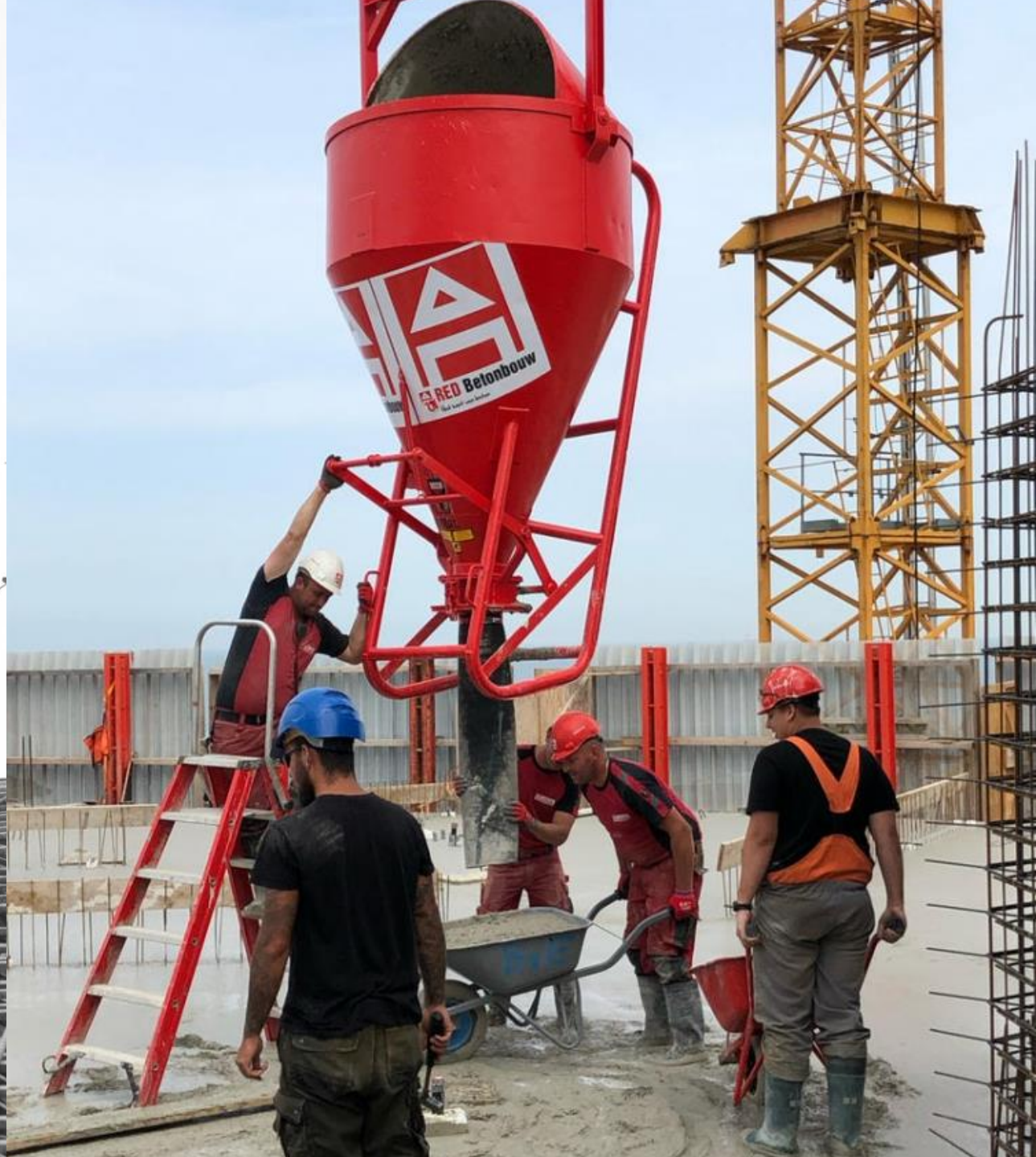
3D Concrete Printing

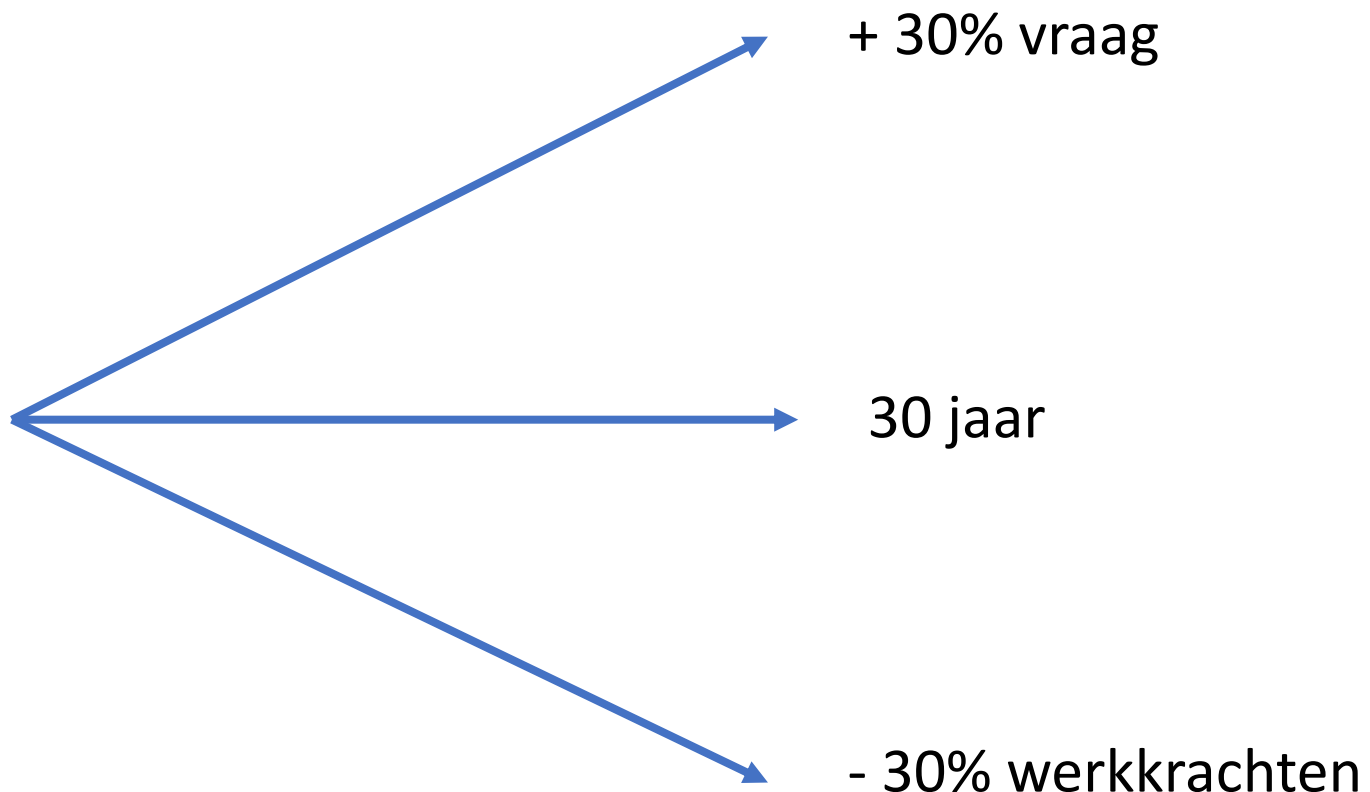
Jolien Van Der Putten

Jolien.Van.Der.Putten@witteveenbos.com









Doel:

- Verdubbelen van de constructiecapaciteit
- CO₂ uitstoot 95% lager



+

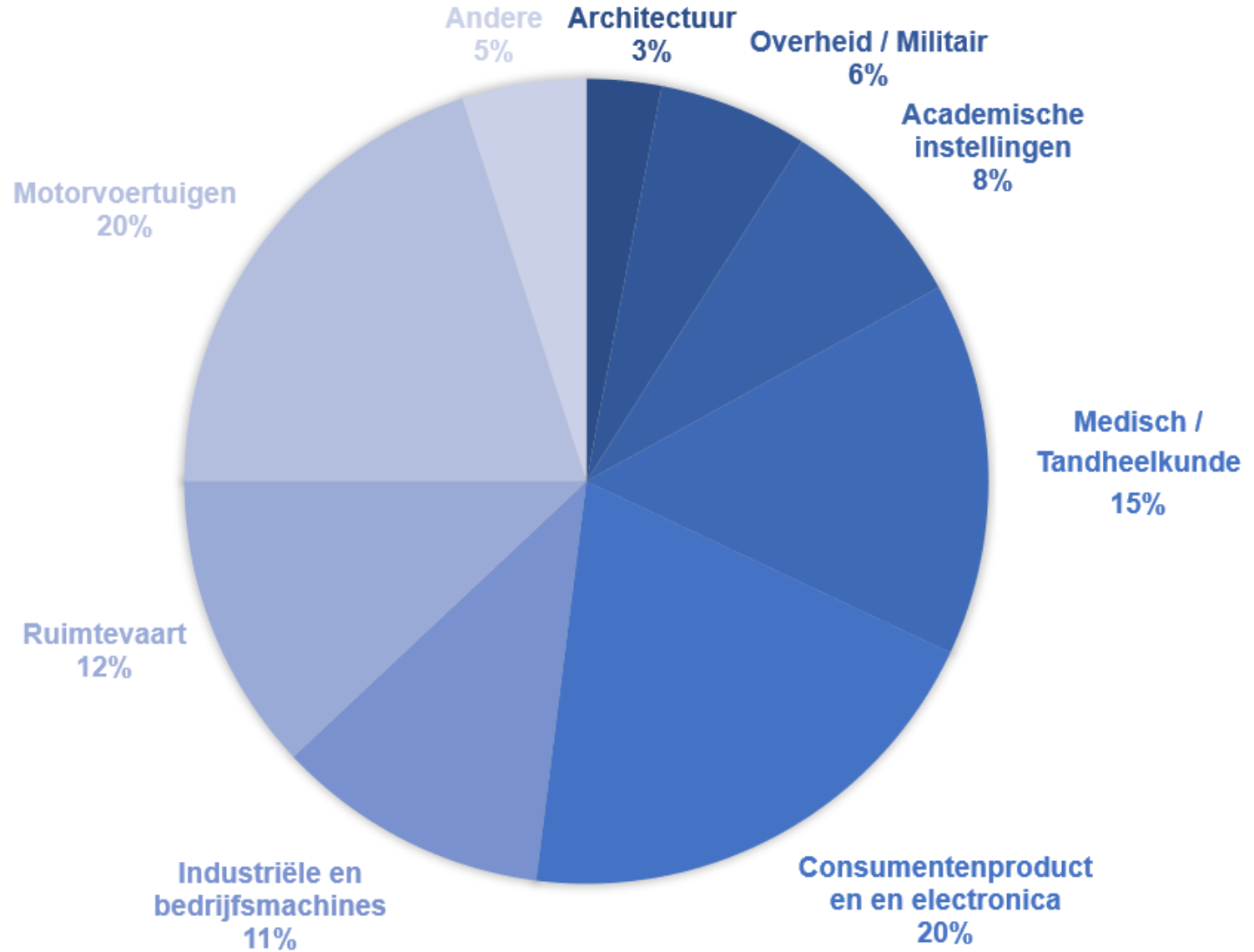


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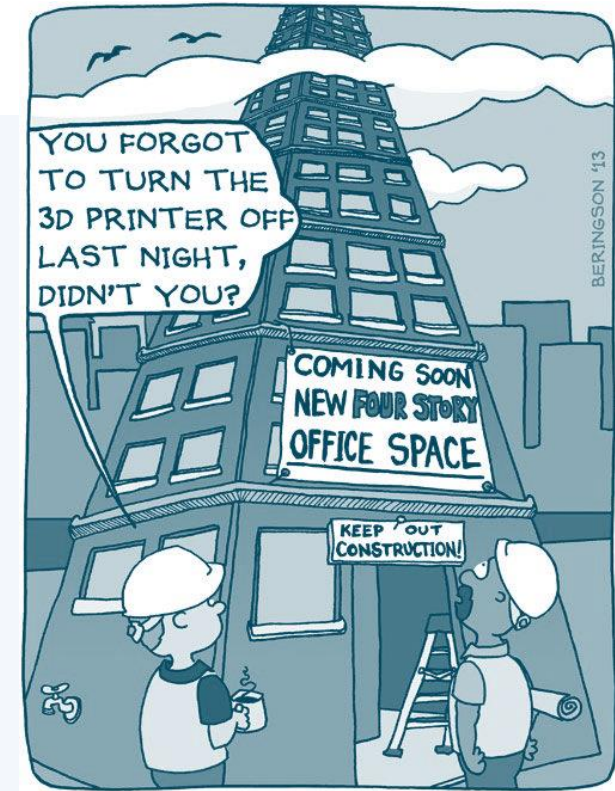
3D PRINTEN

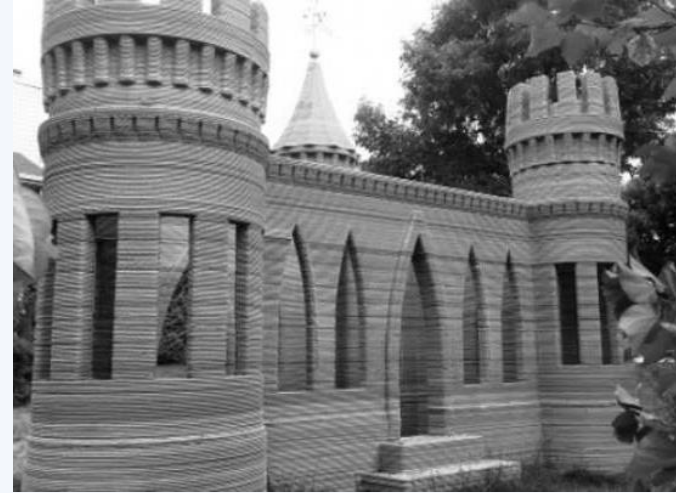
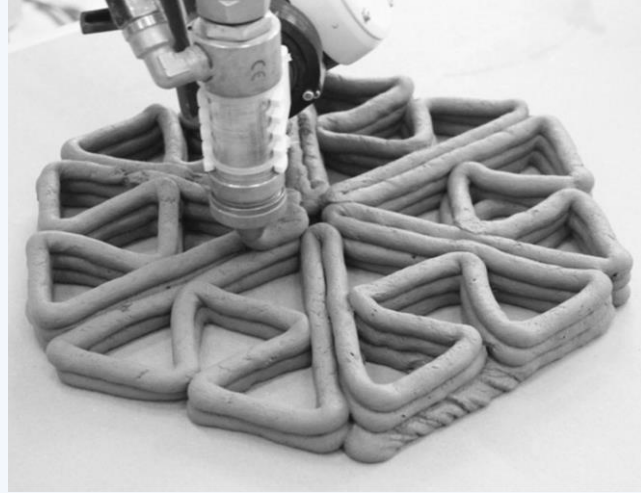
Verschillende
sectoren



Voordelen

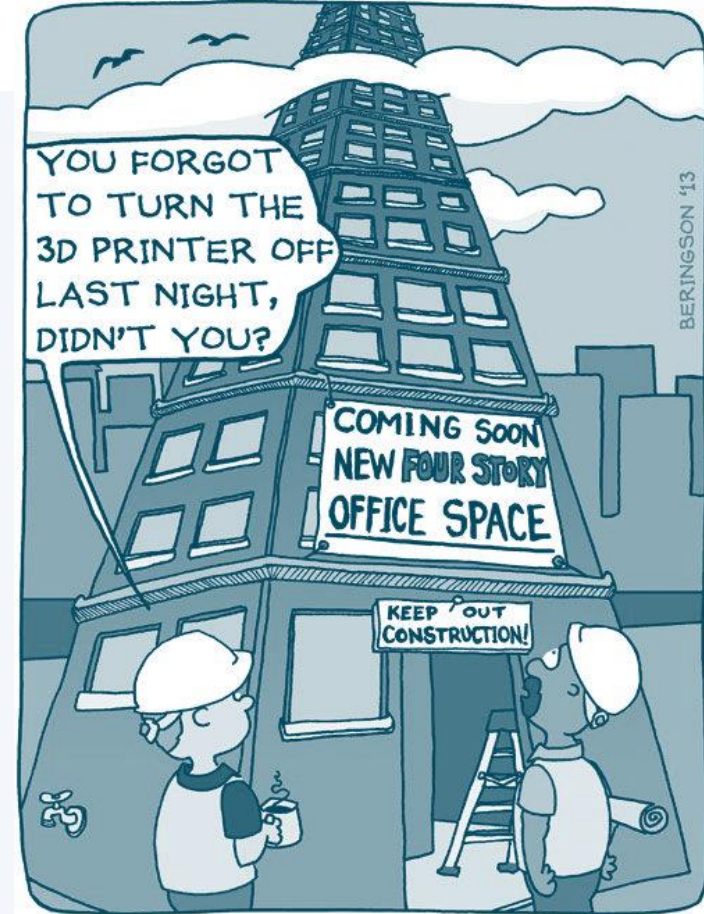
- Gereduceerde constructiekost: geen bekisting vereist
- Minder arbeidsintensief
- Versnellen bouwproces
- Meer flexibiliteit en architecturale vrijheid
- Minder materiaalverspilling
- Hoger veiligheidsniveau





Voordelen

- Gereduceerde constructiekost: geen bekisting vereist
- Minder arbeidsintensief
- Versnellen bouwproces
- Meer flexibiliteit en architecturale vrijheid
- Minder materiaalverspilling
- Hoger veiligheidsniveau



Onderzoek



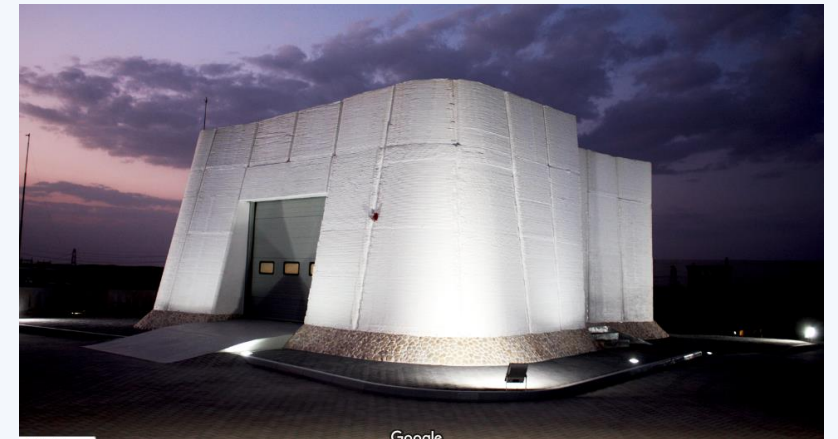
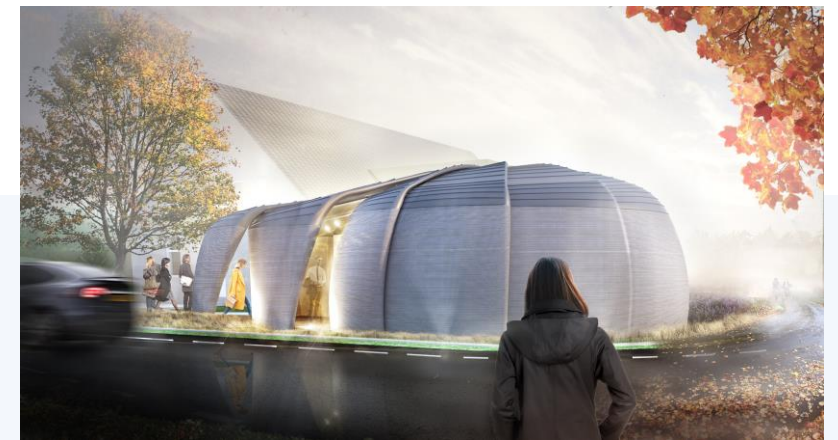
Praktijk



3D Printen in België

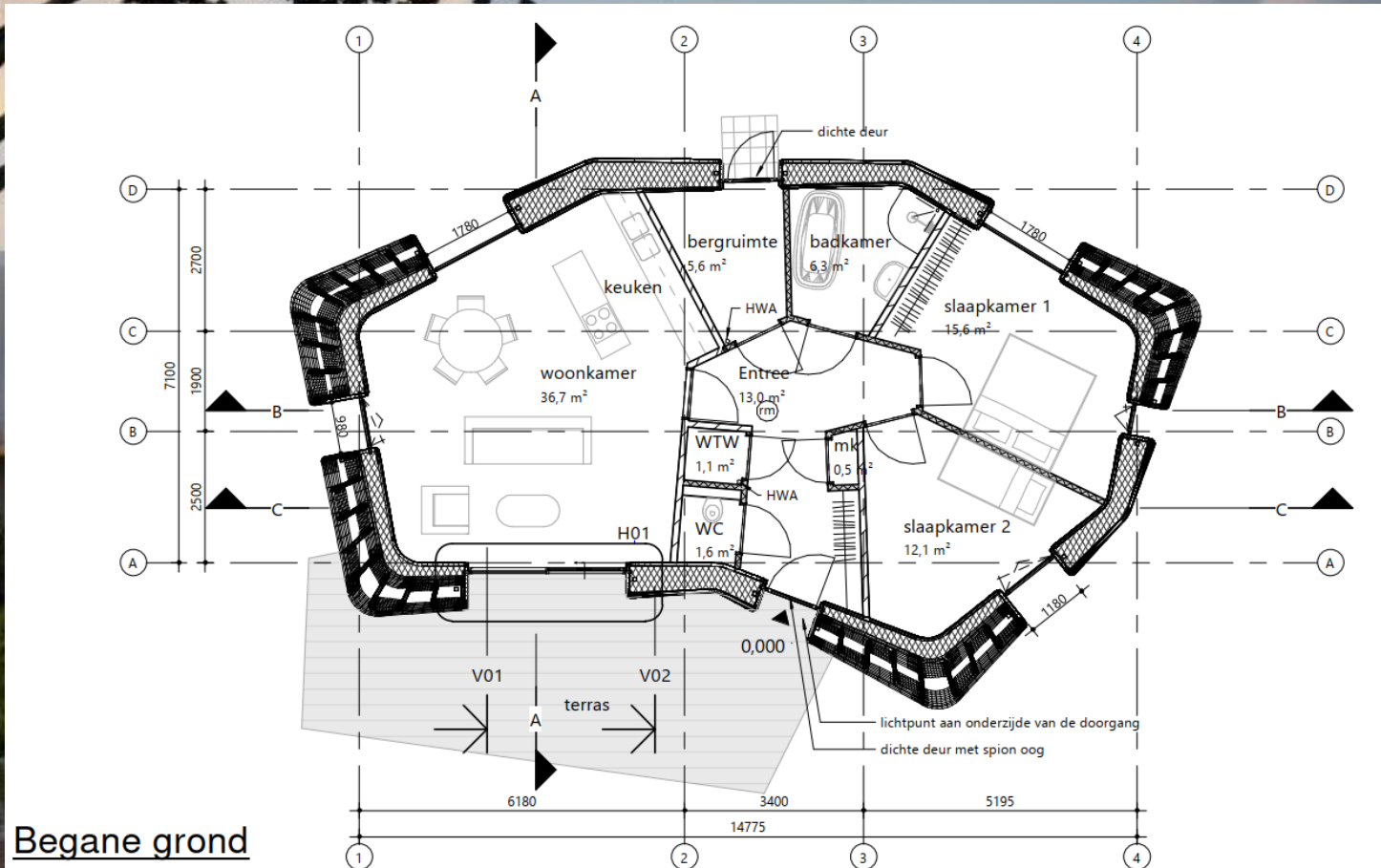


3D Printen Nederland





Milestone

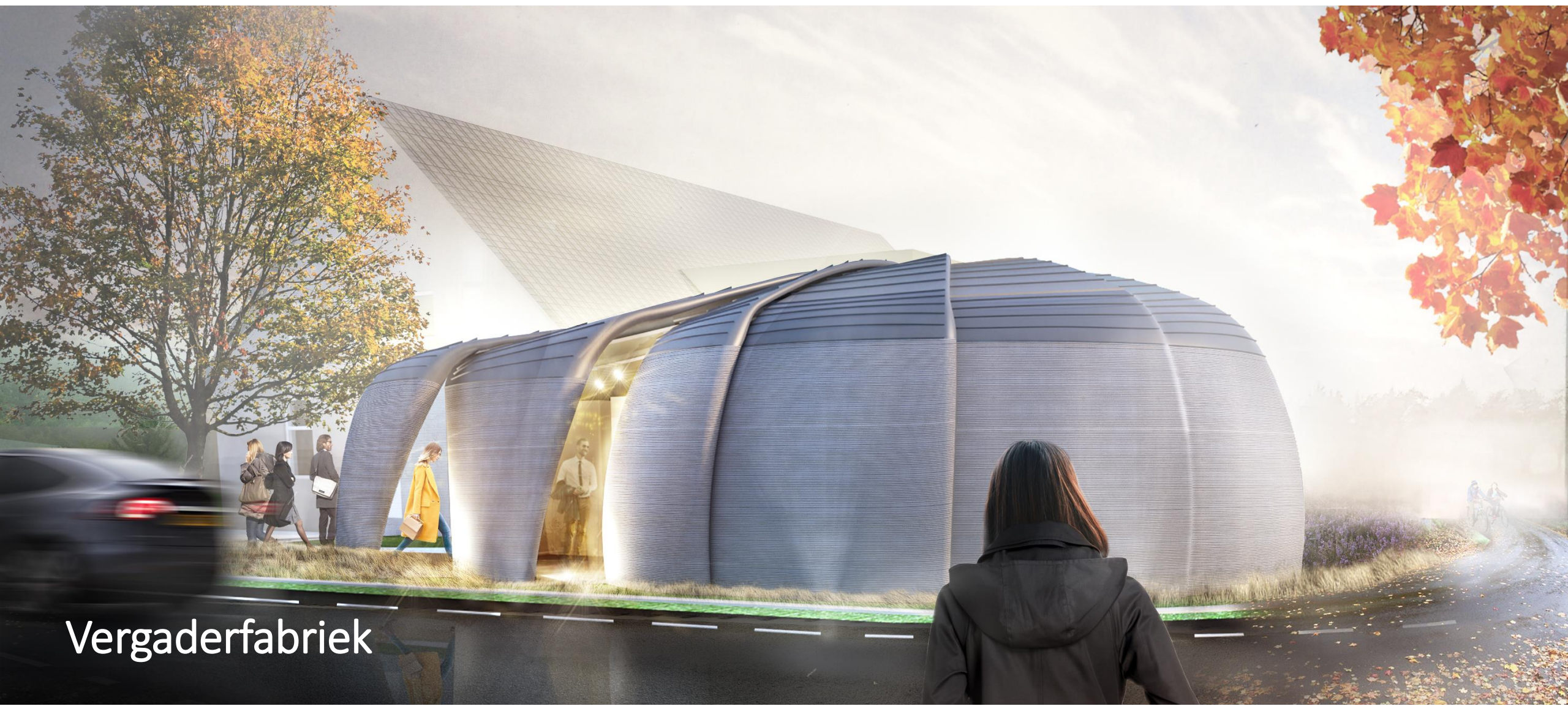


Begane grond



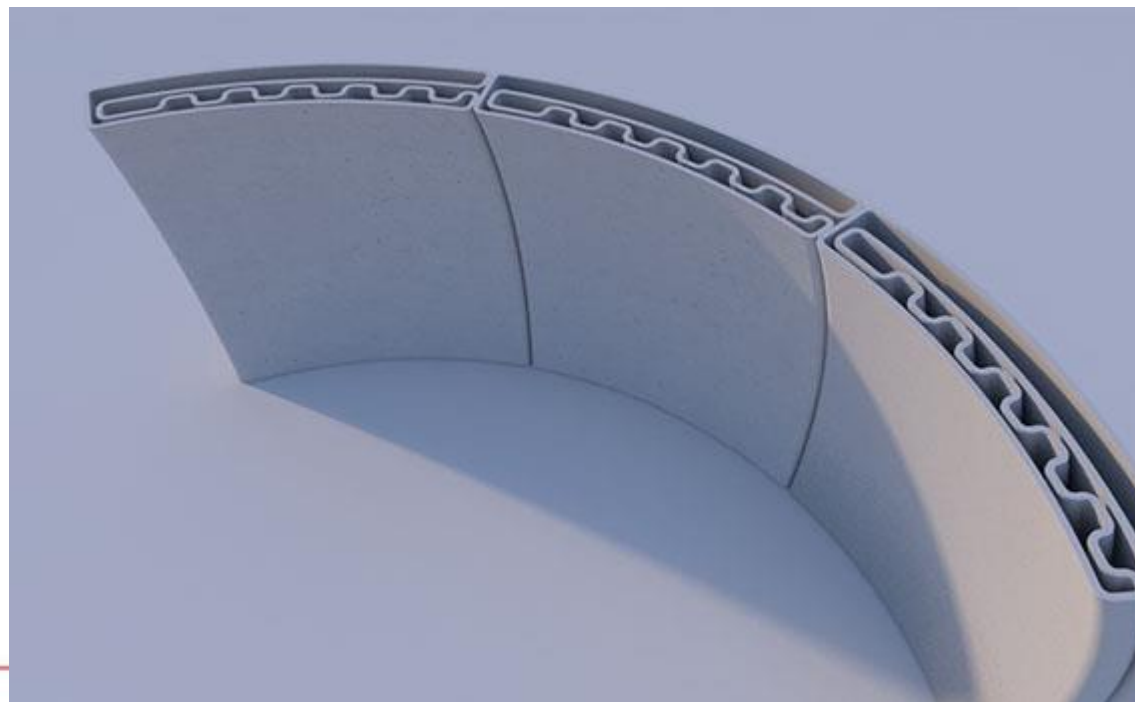
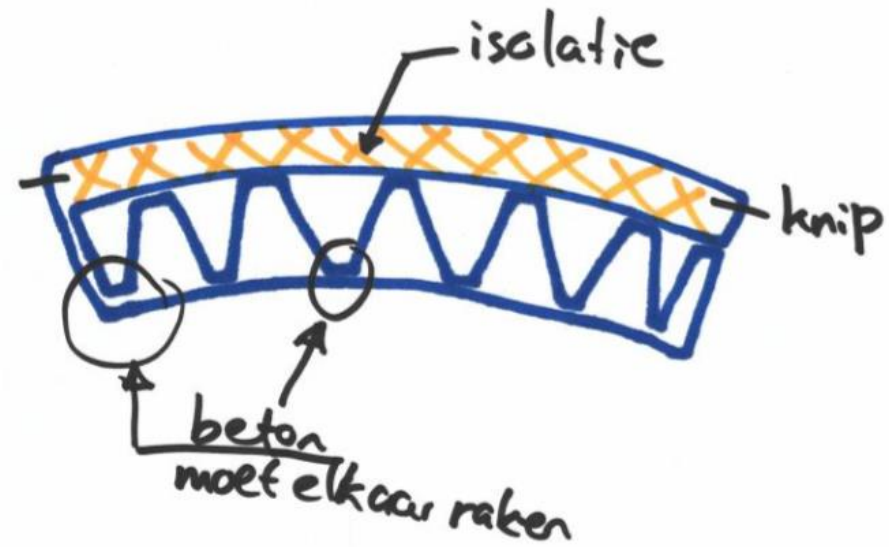
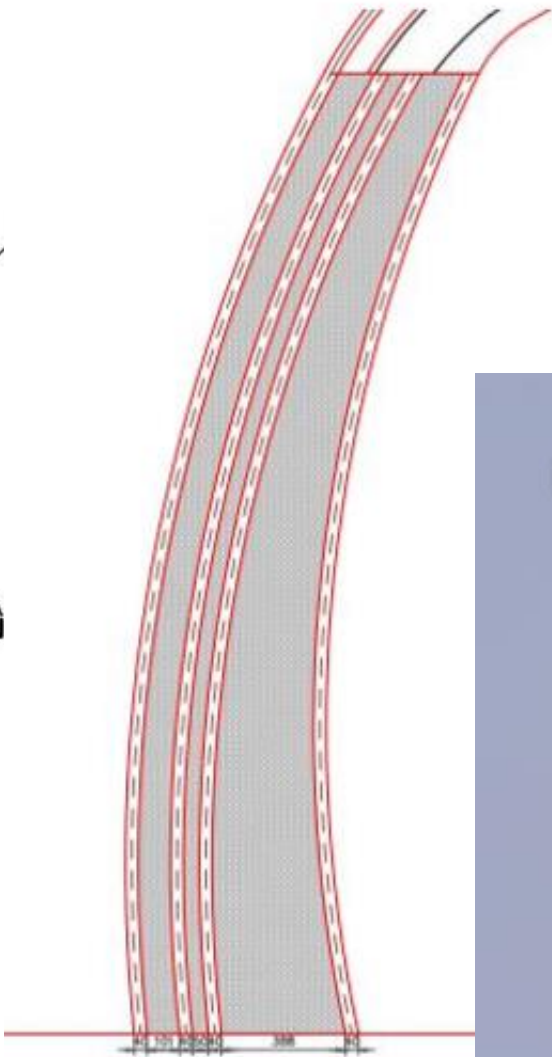
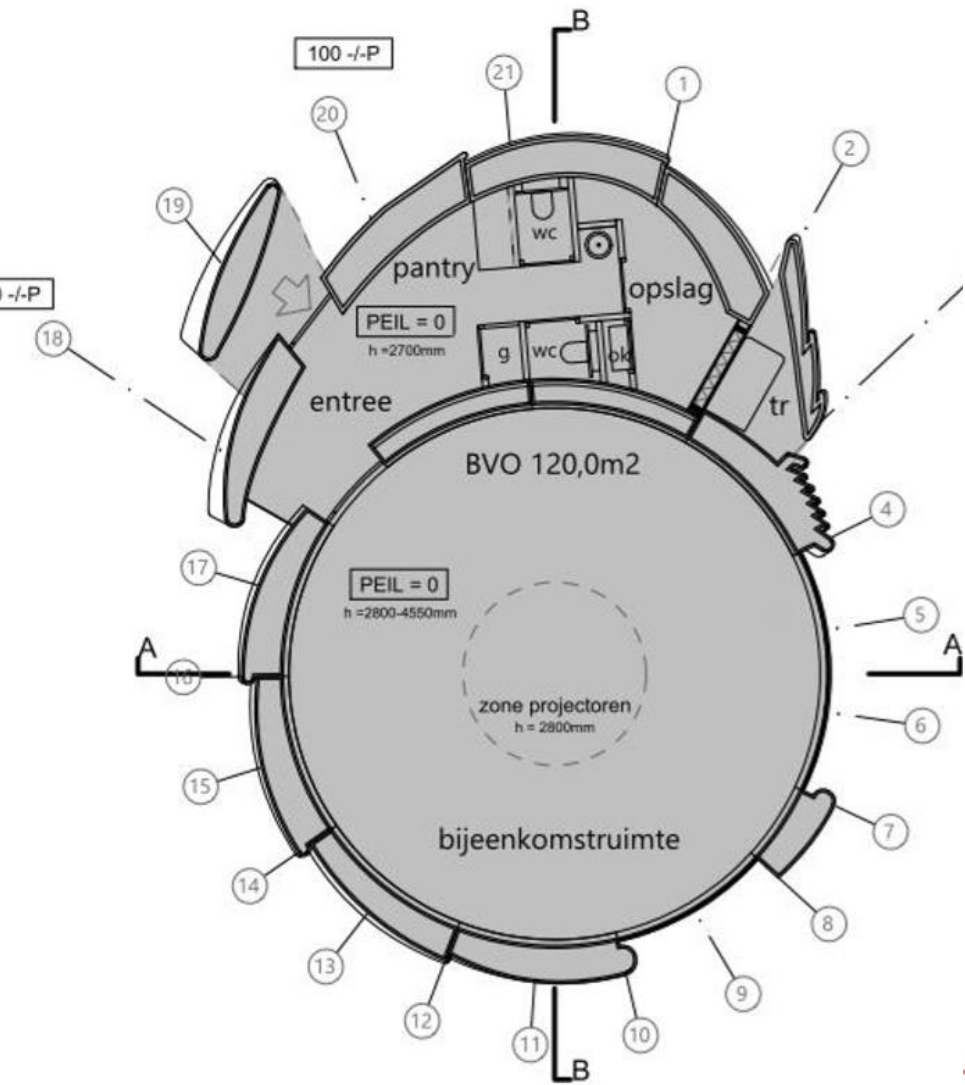
Witteveen + Bos





Vergaderfabriek

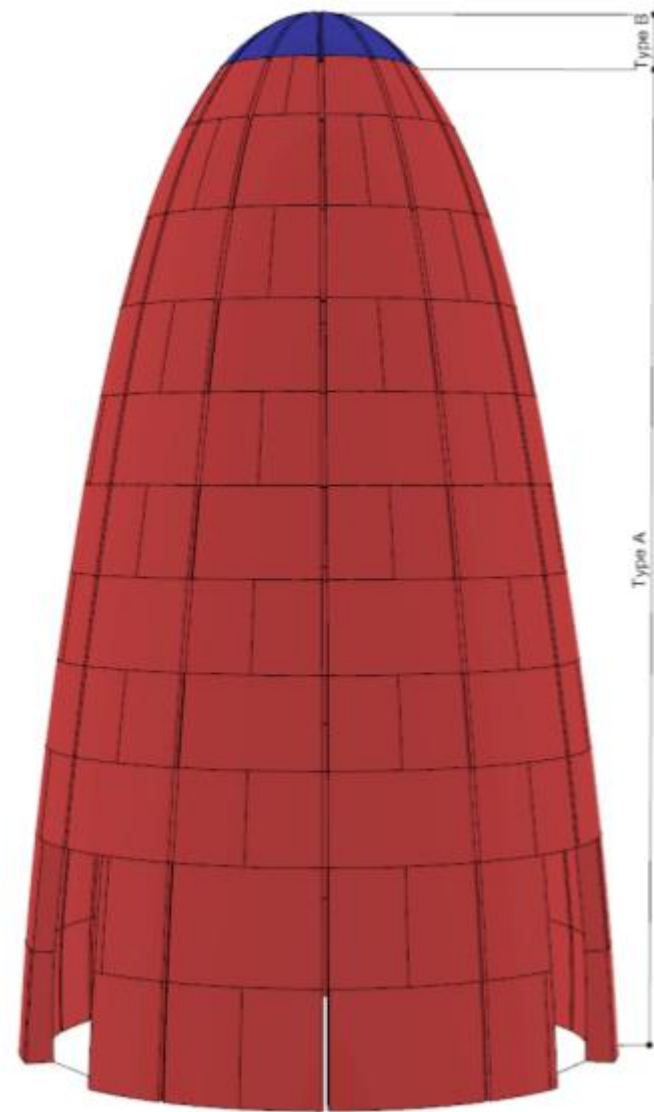
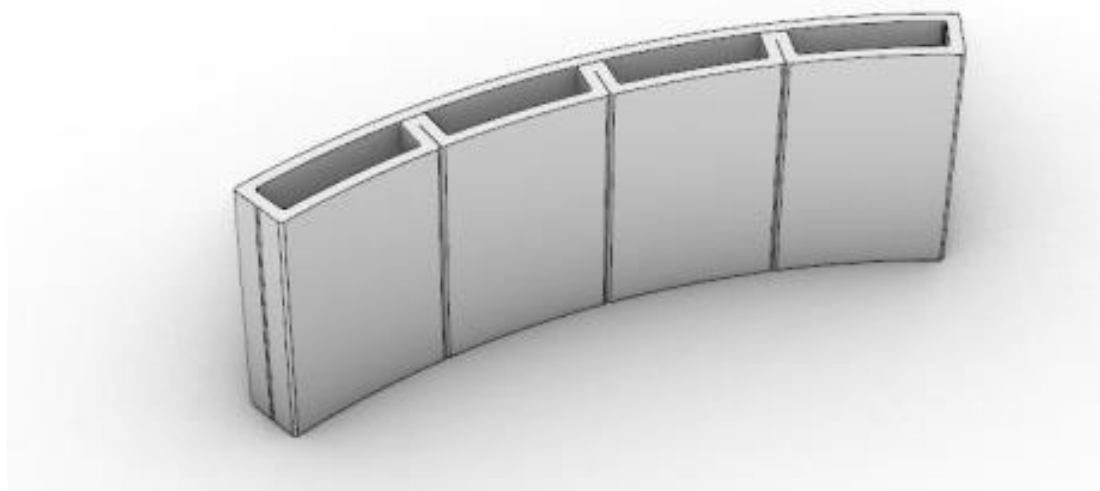
Witteveen + Bos

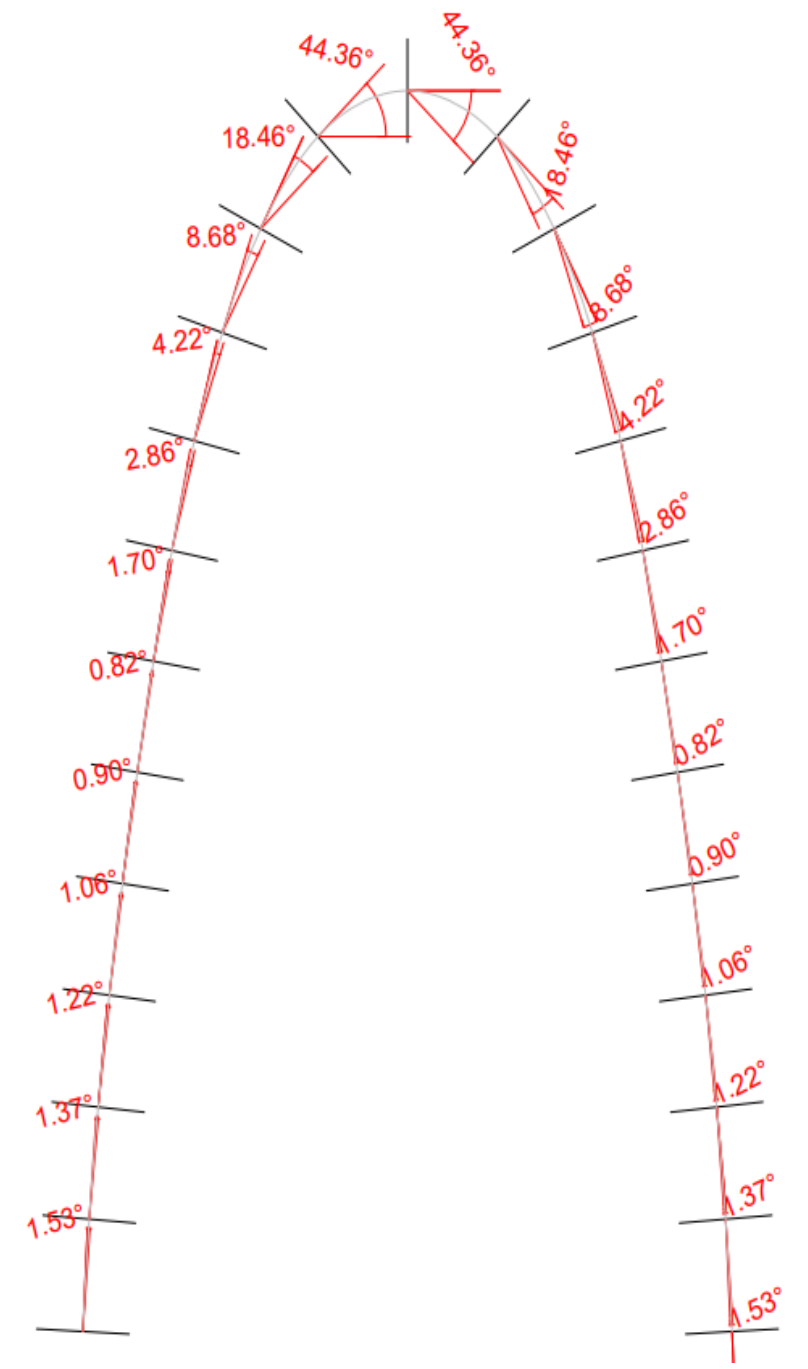
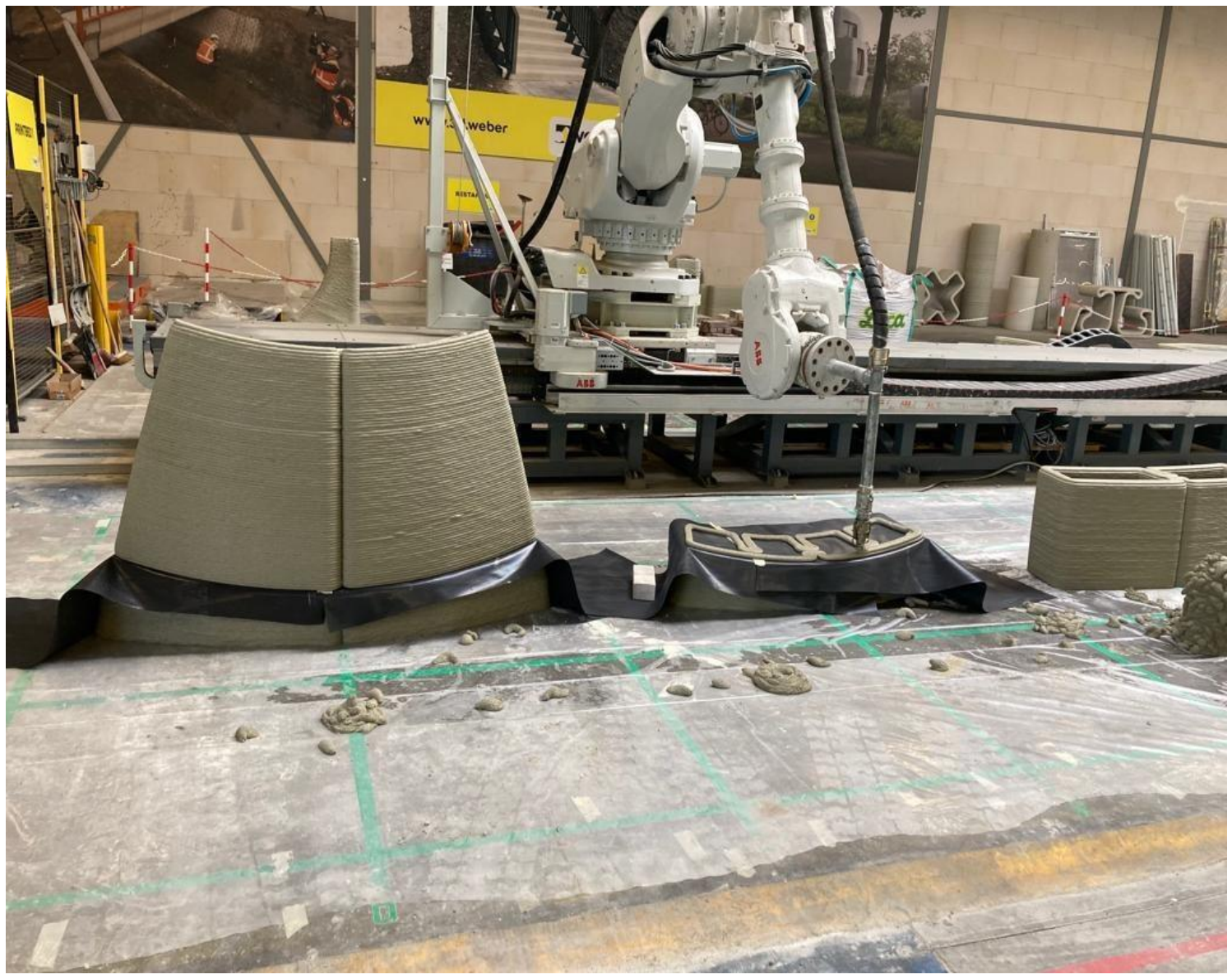




Burj Al Hamman



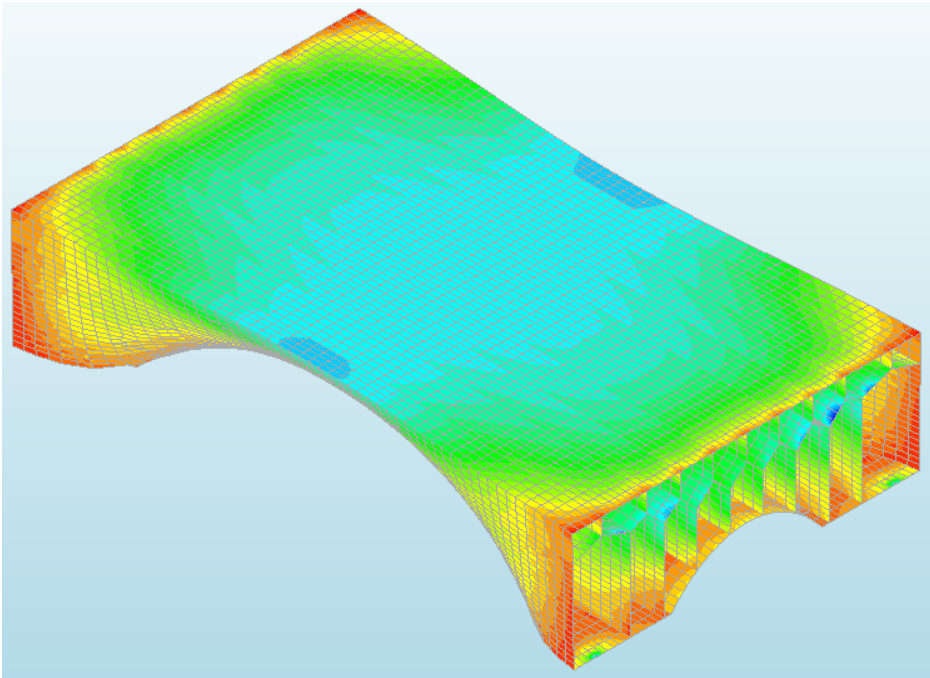








Brug Nijmegen (2018 – 2021)



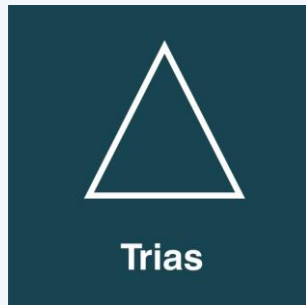




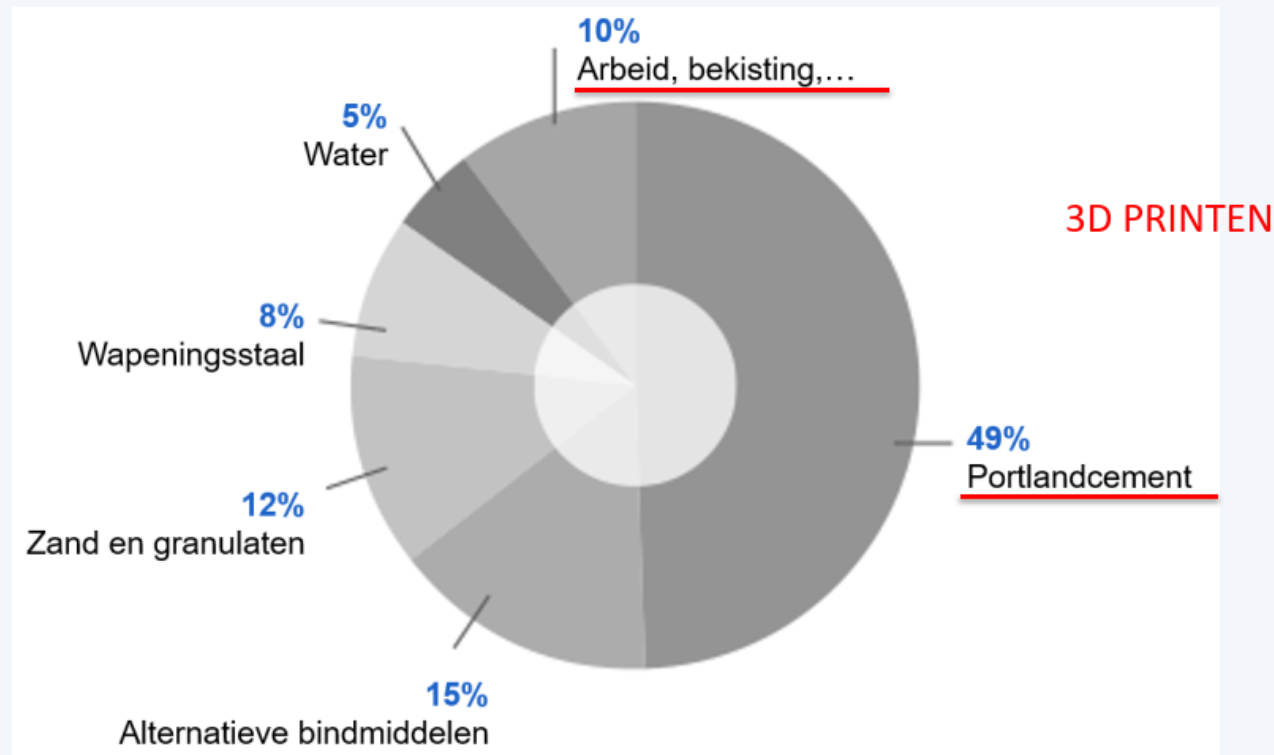
WHAT'S
NEXT?

?

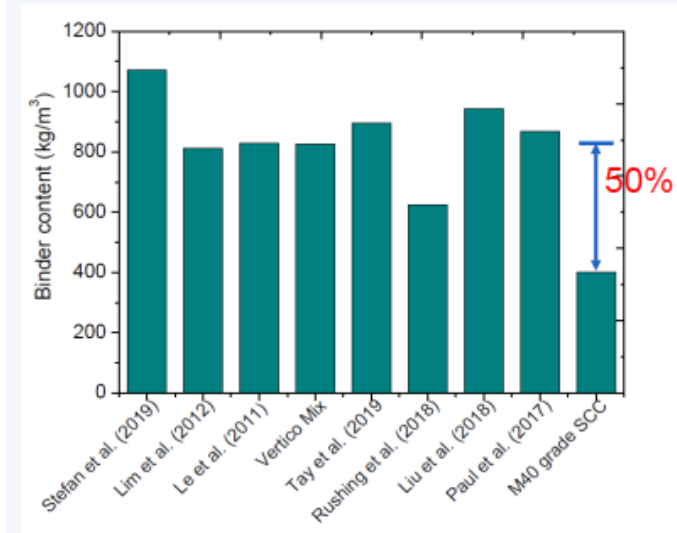
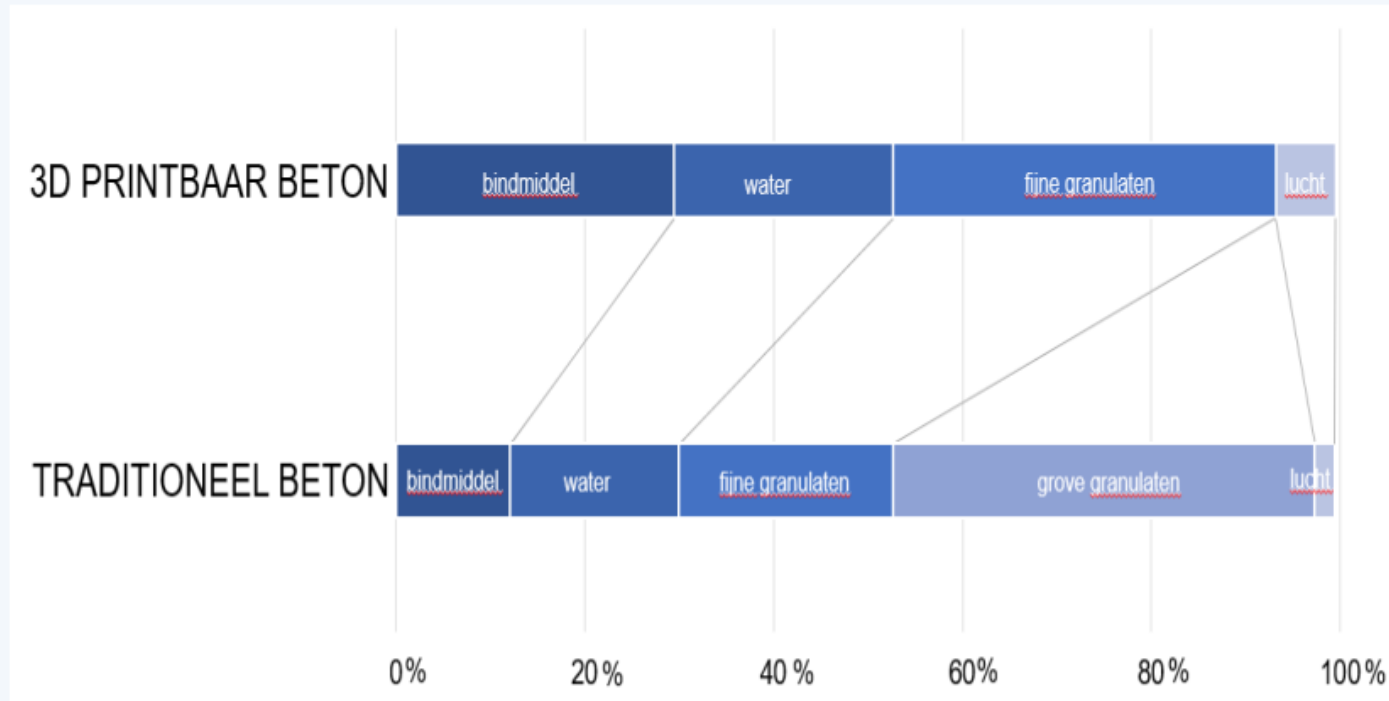
Duurzame ontwerpprincipes in 3DCP



Duurzaamheid: proportionele CO₂-uitstoot



Duurzame samenstellingen



Mohan, M., et al., Extrusion-based concrete 3D printing from a material perspective: A state-of-the art review. Cement and Concrete Composites, 2021. 115C: p. 103855.





RESOURCEFULL

□ cc kg t m m m m³ l m m c m m l m m²

k m m m² ° m m² m l k l m g d l m m² l t k l c m² m k l l m g m m m² t m m²

d l m m³ ° F t c c g m m m² k g c m² k l g m k g m g m m² m m m³ c m² m m³ m

m m m g m g m l m m³ m m m t m m³ k l l k g 12/05/2022 Mechelen

Agenda

1. ResourceFull
2. Low carbon concrete
3. Concrete 3D-printing
4. SIM MaRes 3D2BGreen



Your engineering partner for low carbon concrete

- A young and vibrant company strongly motivated to **reduce the ecological footprint** of the construction industry
- Turning inorganic **waste streams** into low carbon concrete solutions
- Integrated in the **network** of large metallurgical companies as well as large construction groups
- 11 team members passionate about **concrete innovation**



Your engineering partner for low carbon concrete



Pre-treatment and analysis

- Chemical analysis
- Mineral analysis
- Crushing/grinding
- Sizing and separation
- Thermal processing



Binder development

- Alkali activation
- Cement replacement
- Acid activation
- Carbonatation
- Mg-cement



Product development

- 3D-printing mortar
- Acid resistant mortar
- Floor screed
- Ready-mix concrete
- UHPC



Performance testing

- Aggregate testing
- Workability
- Strength testing
- Freeze-Thaw
- Carbonatation



Non-technical

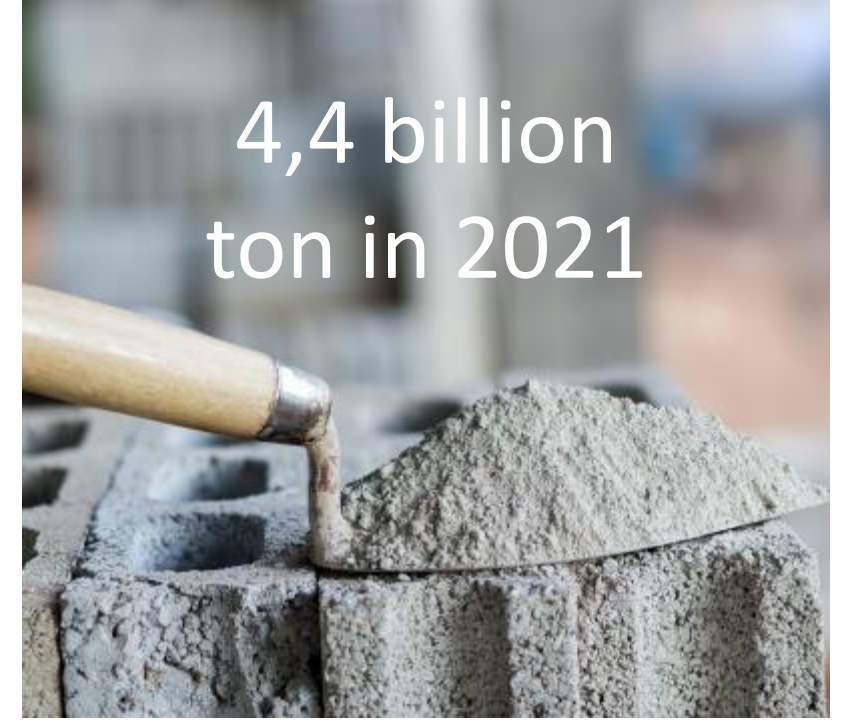
- Industrial implementation
- LCA
- Waste legislation
- Building legislation



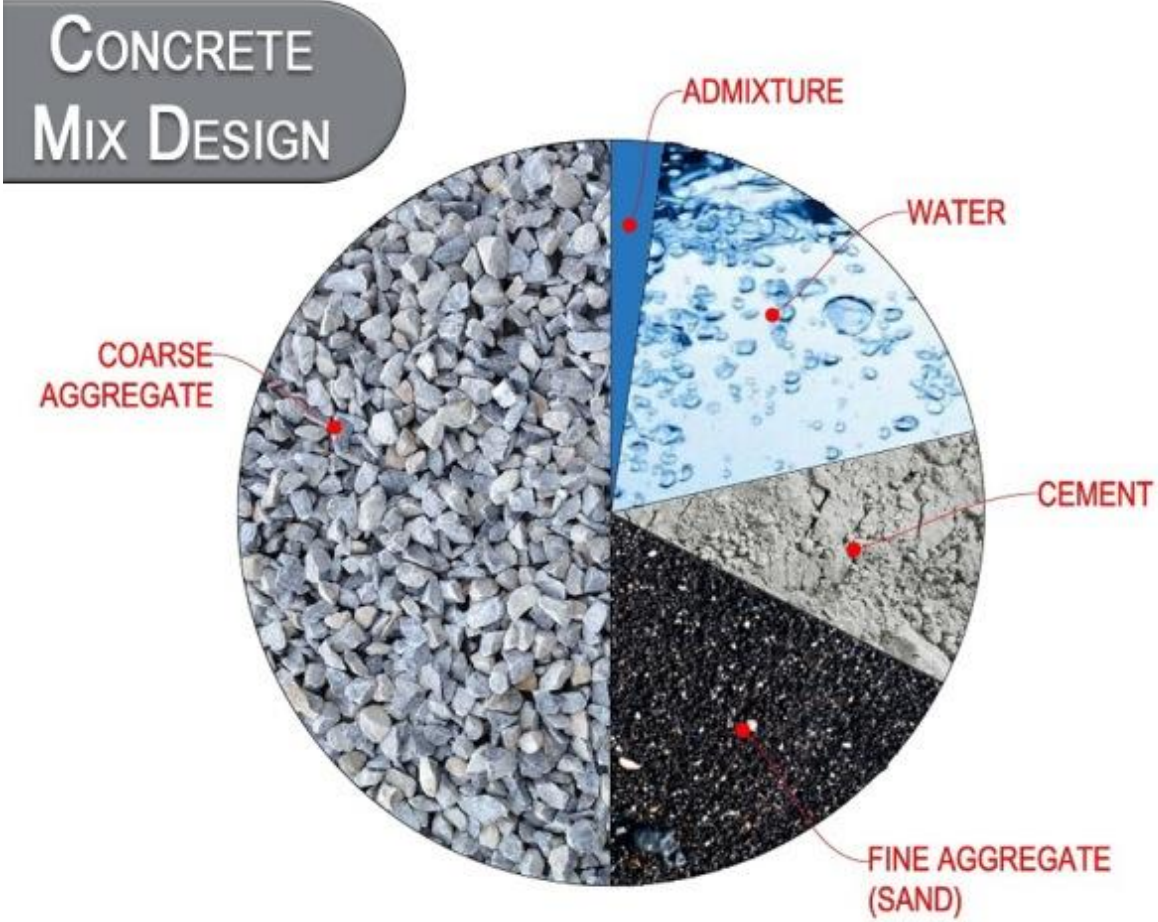
Low carbon concrete



Low carbon concrete: why?



What is concrete?



CEMENT Production Process



A **highly energy intensive** process, producing roughly 0,85 ton of CO₂ per 1 ton of cement produced (*vs. 2,5 ton of CO₂ per 1 ton of reinforcement steel*)

4.4 billion ton of cement is being produced each year, resulting in a contribution of **8-10%** of worldwide **CO₂ emissions**.



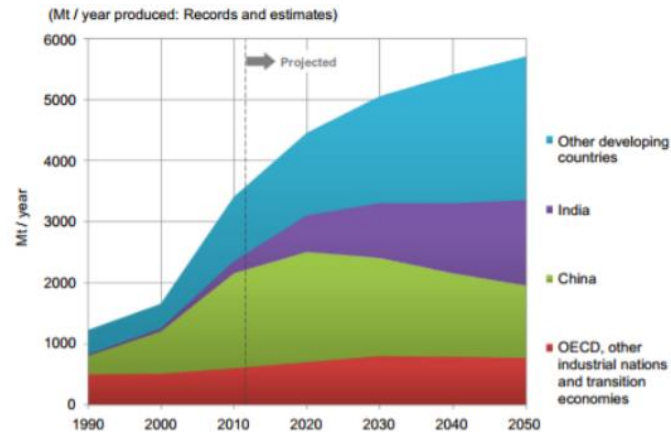
Sustainable concrete: why?



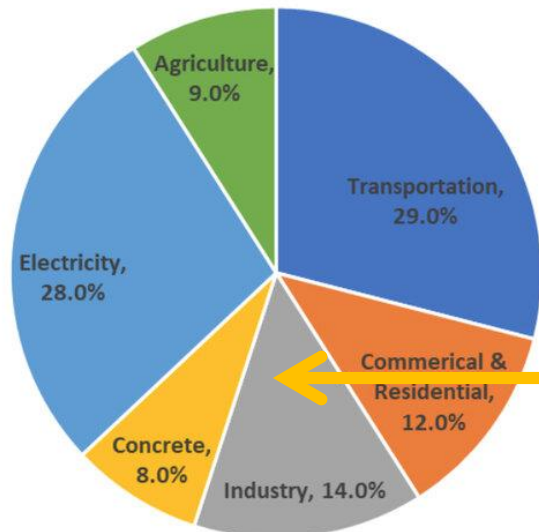
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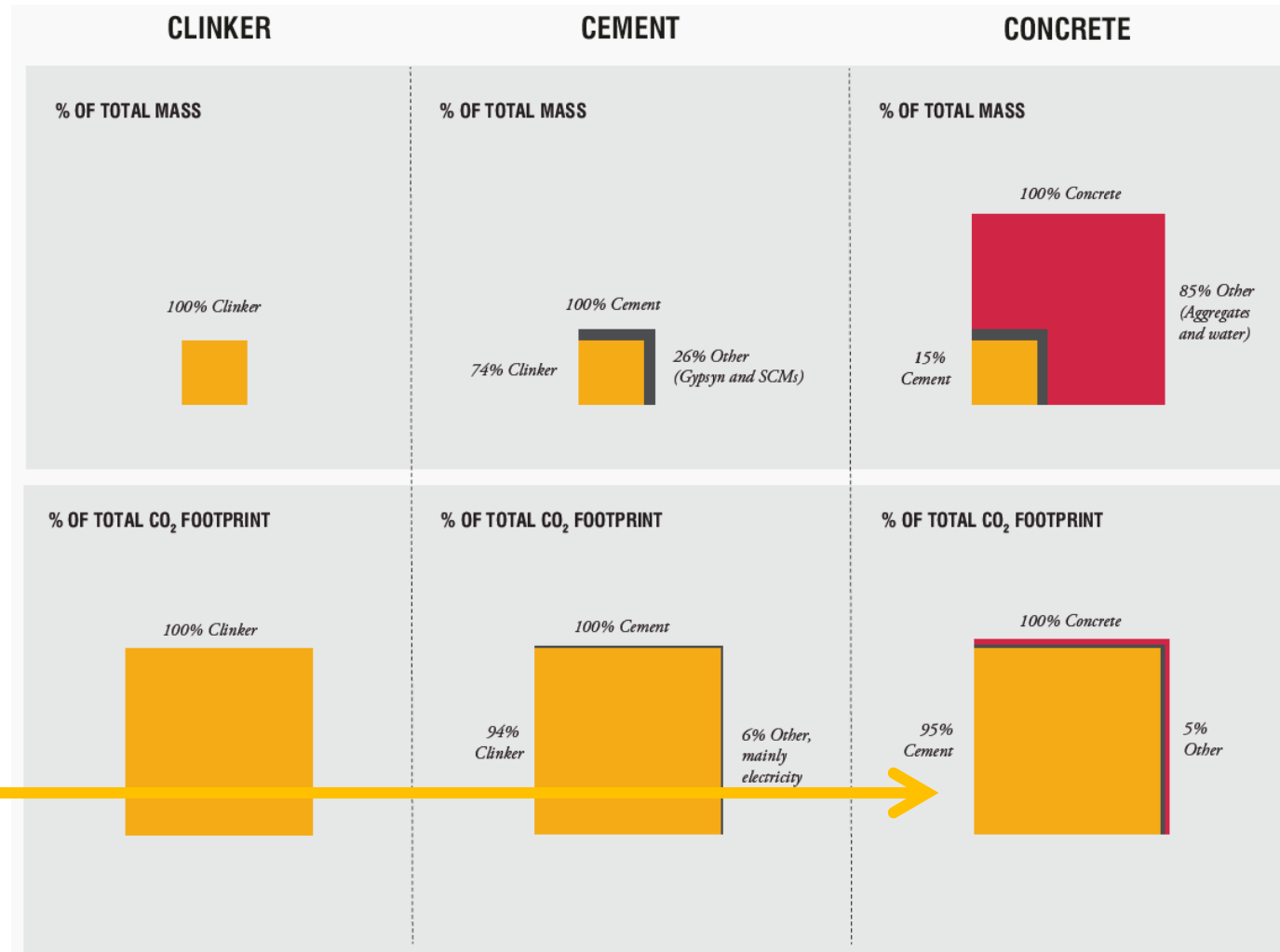
Sustainable concrete: why?



Worldwide cement production



Carbon dioxide emissions by business sector



Sustainable concrete: how?

Technologies applicable at different levels

1. Clinker level

- Energy efficiency
- Alternative fuels
- Carbon capture & storage



2. Cement level

- Clinker ratio (SCMs)
- Optimal grinding/blending of blended cements
- Non-Portland binders

3. Concrete level

- The right cement for the right application
- 'overdosing'

4. Structural level

- Alternative building solutions to concrete
- 'overdesigning'

5. Recycling, circular economy

- Recycling concrete
- Recycling cement



Concrete 3D-printing

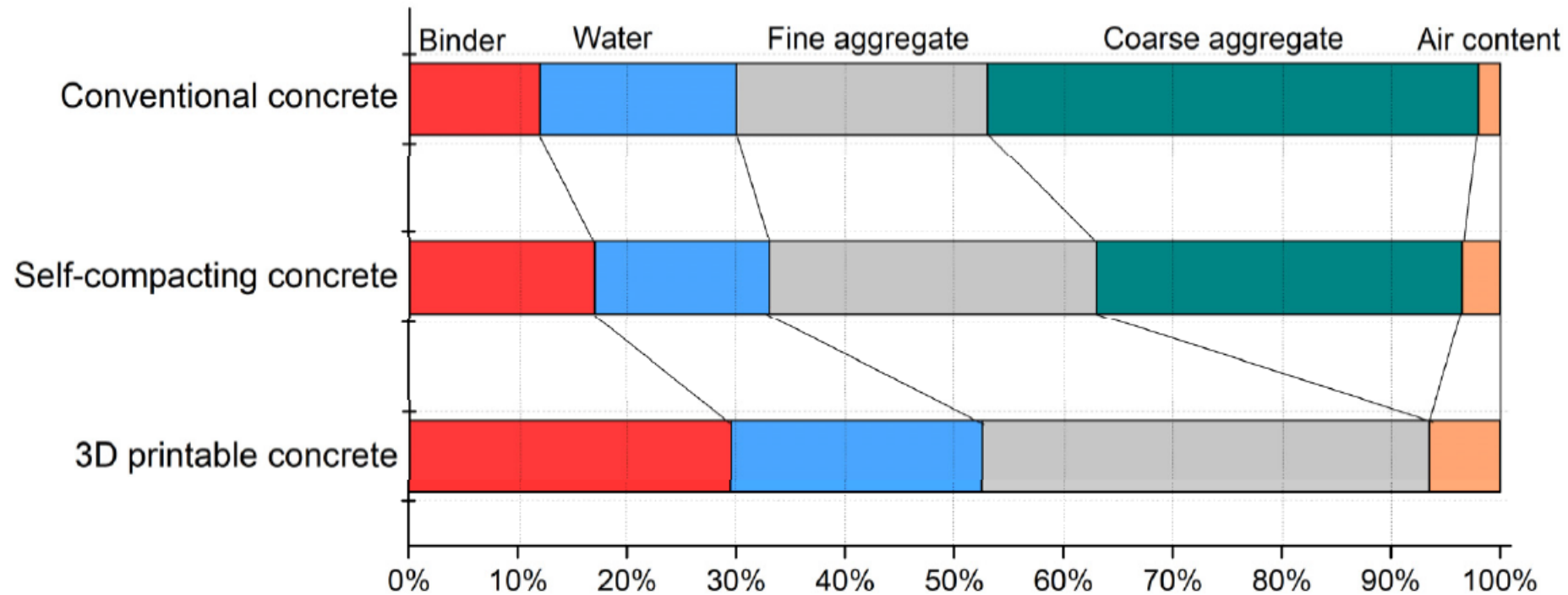


Benefits of 3D printing

- Consumption of material is optimized
- Freedom of design
- Less construction waste
- Labor cost saving



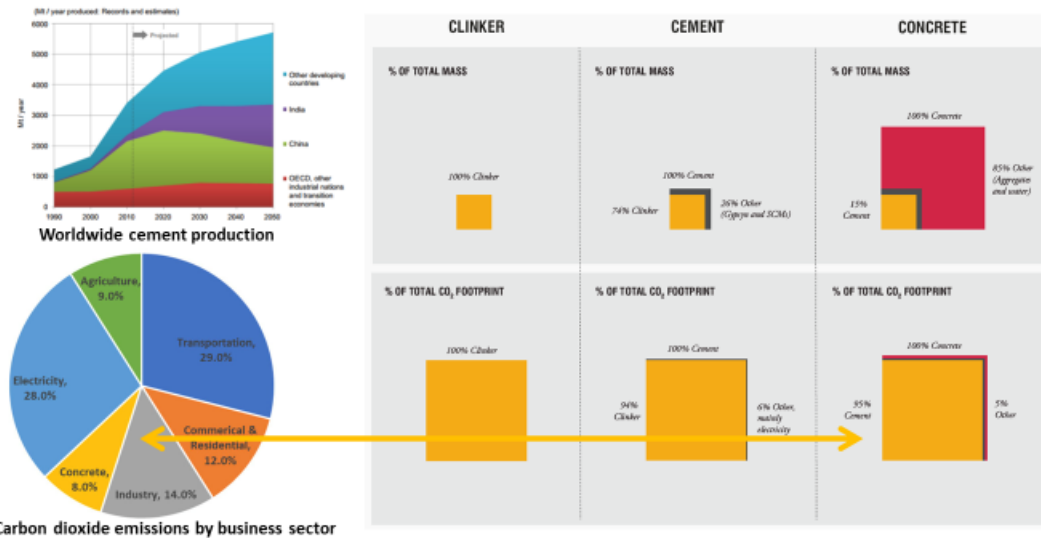
But the materials we consume make a difference



The binder content increases by 250% compared to conventional concrete

But the materials we consume make a difference

Sustainable concrete: why?



Remember this previous slide?

95% of the carbon footprint in traditional concrete is attributed to the binder.

→ In concrete 3D-printing the need for sustainable concrete binders is of crucial importance

3D2BGreen





- A [SIM MaRes](#) project between Universiteit Gent, BESIX 3D, Witteveen+Bos and ResourceFull
- We developed a [sustainable 3D-print](#) mixture based on our patented [ZeroCem](#) technology





RESOURCEFULL

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Building a greener future, together