

EmiratesGBC Technical Workshop

# 3D Concrete Printing in Construction

Luai Kurdi

BESIX3D 23/07/2019



**2.3Bn**  
EUR



**15,000**



**100+ years**



**Privately  
Owned**



**66%**



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# A CULTURE OF INNOVATION

# A strong regional footprint

50+ year in the Middle East



First Contract, Corniche  
Abu Dhabi



Sheikh Zayed bridge



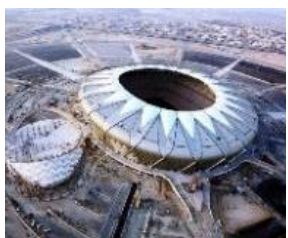
Sheikh Zayed Grand  
Mosque



Burj Khalifa



Ferrari World & Yas mall



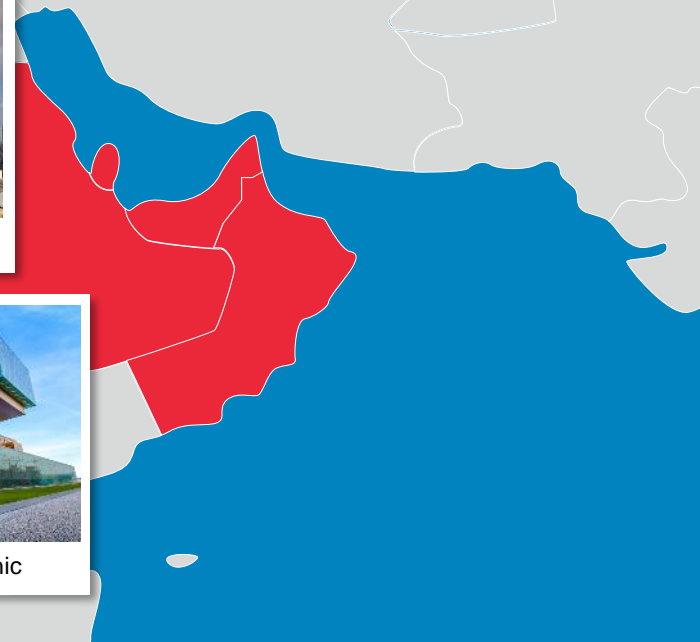
King Abdullah Sports City



Four Seasons Hotel



Cleveland clinic



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# 3D TO DISRUPT CONSTRUCTION INDUSTRY?

# Technology Look Back

Soon to be disruptive?

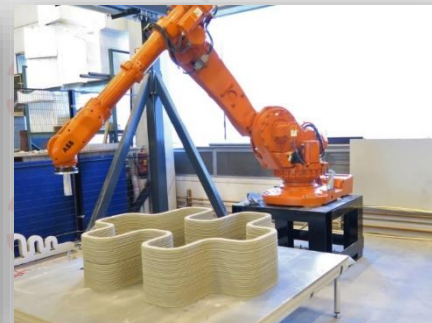
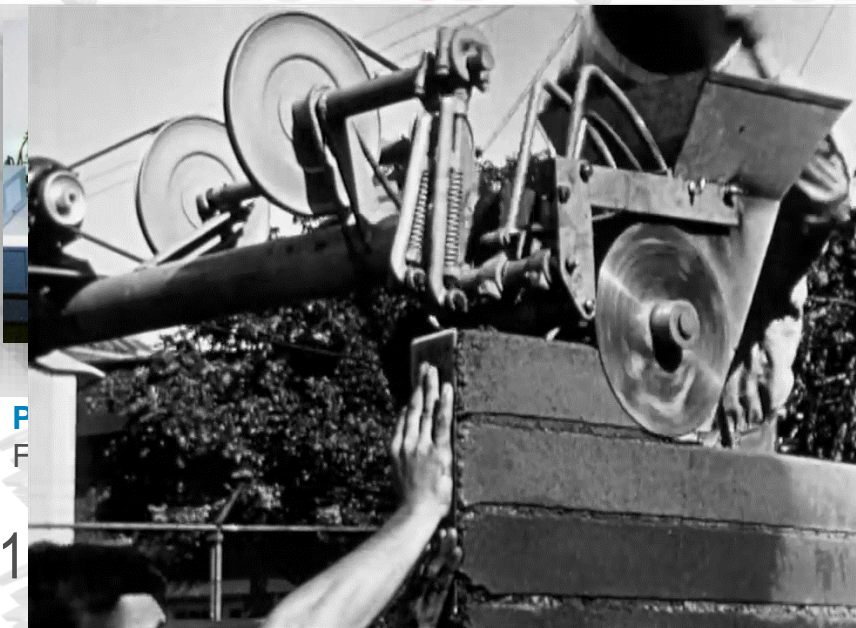


## Wall Building Machine

Similar Technique

 YouTube

1942



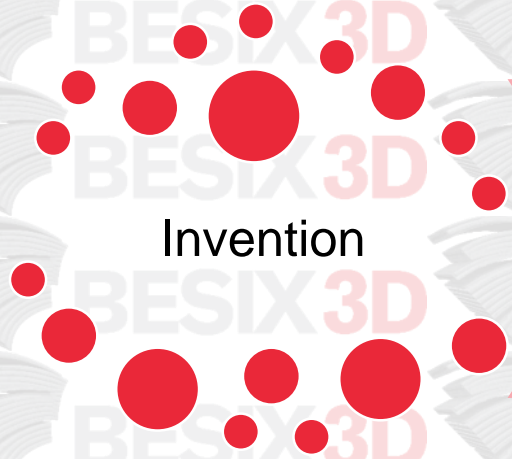
## Disruption? Scale-up?

Construction sector piloting

2019?

# 3 steps to Mainstream Adoption

Cross Industry view



Invention

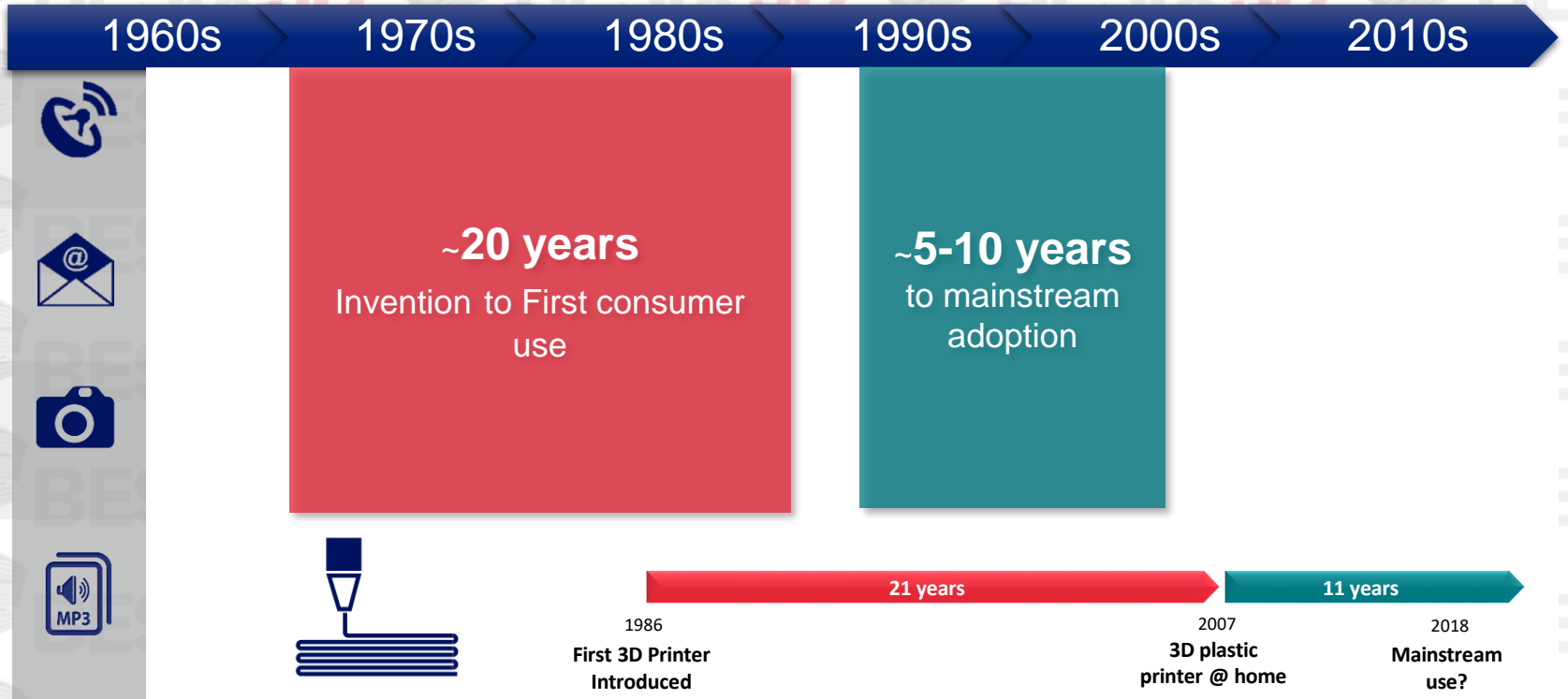


First Commercial  
use



Mainstream  
market

# Path to Mainstream Adoption







# SPOTLIGHT

# 3D Concrete printing

## Status Quo



### Opportunities

- ✓ Freedom of design form
- ✓ New shapes (hollow, convex, round)
- ✓ Highly detailed & precise design
- ✓ Predictability
- ✓ Uniqueness at scale ☆
- ✓ Speed of construction
- ✓ Only concrete where needed
- ✓ Reduce material & waste (40%)
- ✓ Reduce manpower (50-80%)
- ✓ Reduced risk for workers



### Challenges

- ~ Scalability current equipment
- ~ Need for controlled environment
- ~ Lack of qualified experts
- ~ Integration early stages of design
- ~ Regulations

# 21<sup>st</sup> century dilemma

## Customization vs Standardization



“ 3DCP allows to process individual wishes per individual customer.  
Every iteration on existing design entails few costs. ”

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# HOW DOES IT WORK?

# How does it work?

## Printing process





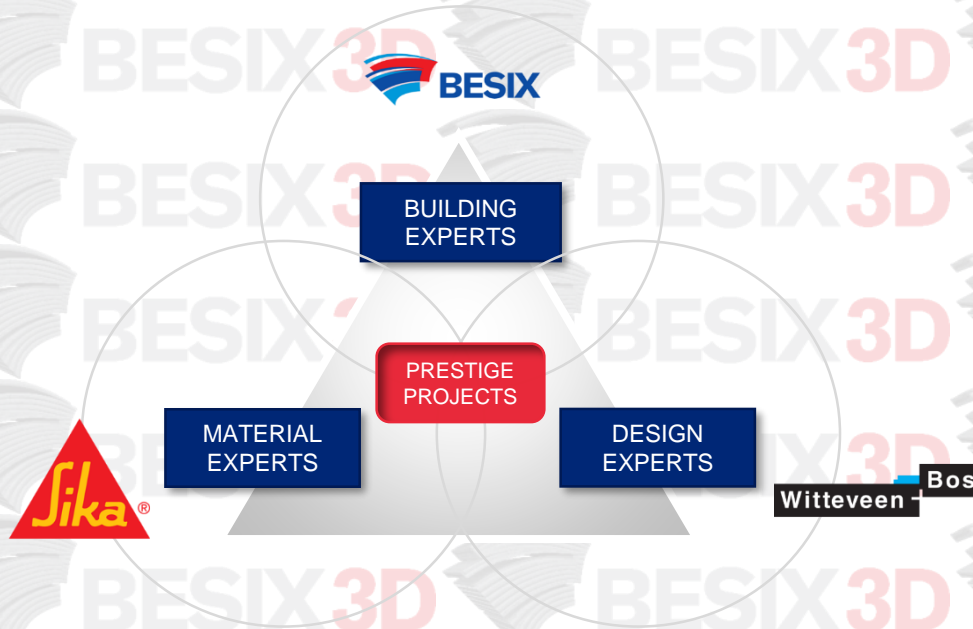
# OUR TECHNOLOGY PARTNERS



3D CONCRETE PRINTING

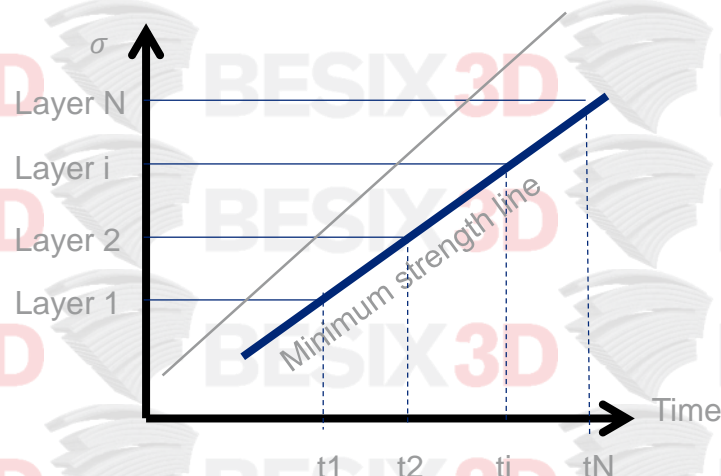
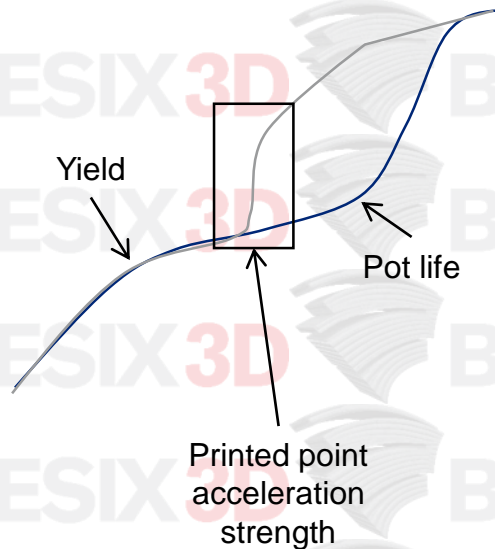
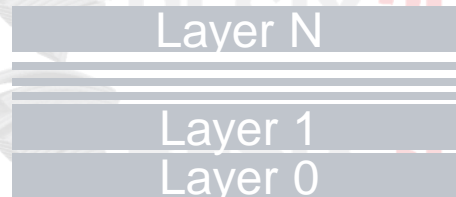


# The Right Partnership



# Partner Sika: Material expert

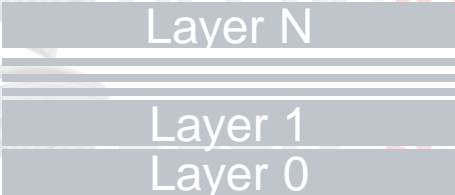
Challenge: Holding the weight





# Partner Sika: Material expert

Challenge: Holding the weight



# Partner Sika: Material expert

Challenge: Interlayer (no breaks)

Layer N

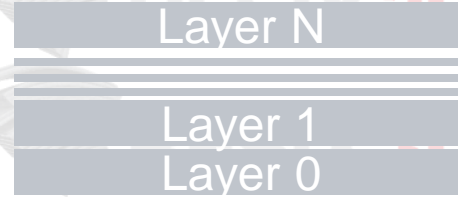
Layer 1

Layer 0



# Partner Sika: Material expert

Challenge: Interlayer (no breaks)



# Partner W+B & TU/e: Technology

Expertise

Witteveen + Bos

TU/e Technische Universiteit  
Eindhoven  
University of Technology



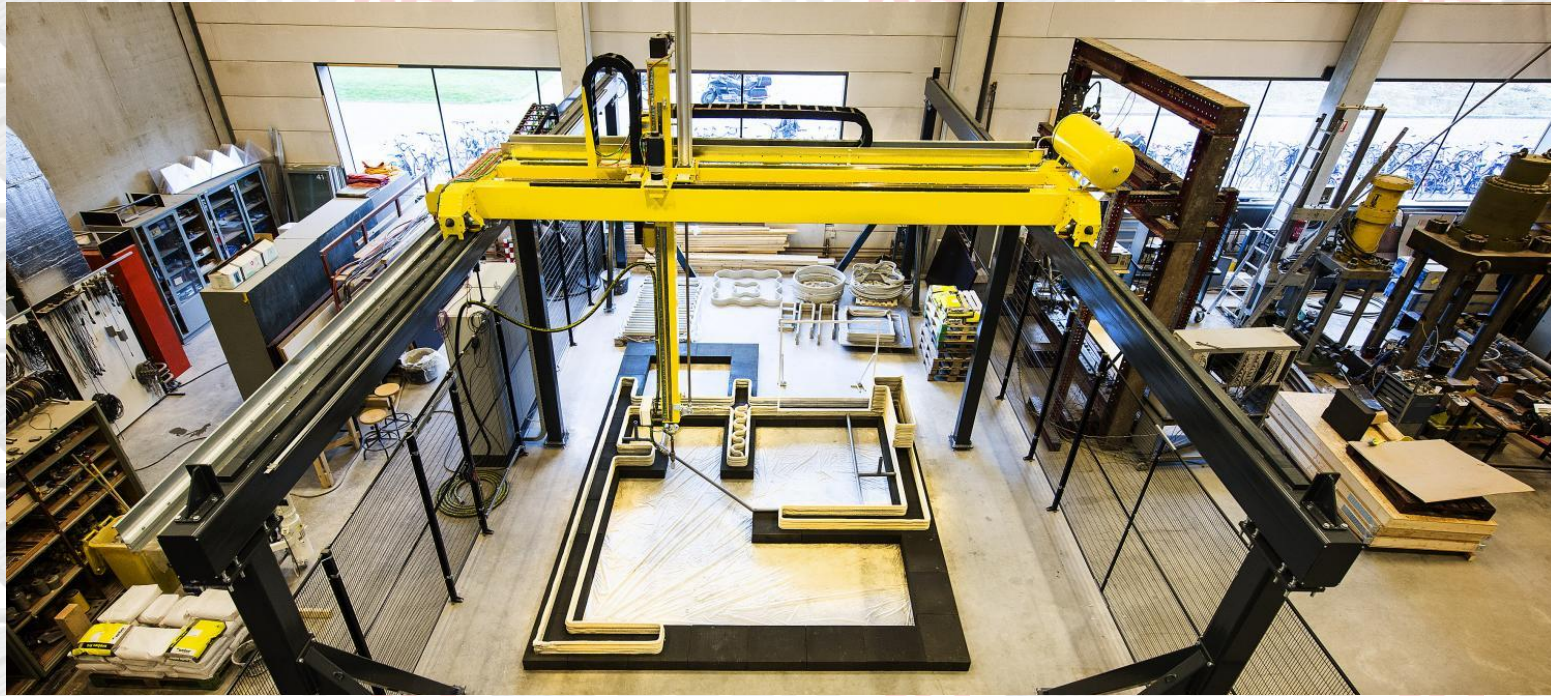
- Working on 3D Concrete Printing since 2014
- Experience and input of previous projects
- Structural calculations according to Eurocode
- 'Design assisted by testing'
- Advanced structural analysis
- Testing & monitoring:
  - Material test
  - Prototype test
  - Lab- and Field tests
  - Monitoring during life cycle



# Our technology partners

Witteveen + Bos

TU/e Technische Universiteit  
Eindhoven  
University of Technology



# Our technology partners

Witteveen + Bos

TU/e Technische Universiteit Eindhoven University of Technology



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# Our technology partners

## Pioneering in the Netherlands



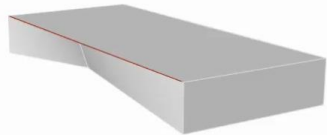
World's first 3D-printed bridge opens to cyclists in Netherlands

Crossing printed from 800 layers of concrete could take weight of 40 trucks, designers say



Witteveen Bos

TU/e



# Our technology partners

## Pioneering in the Netherlands

Witteveen + Bos

TU/e Technische Universiteit Eindhoven University of Technology



### Project Milestone

In the city of Eindhoven (The Netherlands) five 3D-printed concrete houses will be built. The project is the world's first commercial housing project based on 3D-concrete printing. The houses will all be occupied, they will meet all modern comfort requirements, and they will be purchased and let out by a real estate company.



1 FLOOR  
3 ROOMS  
95 M2  
WOODEN ROOF  
EARLY 2020





# Our technology partners

Pioneering in the Netherlands



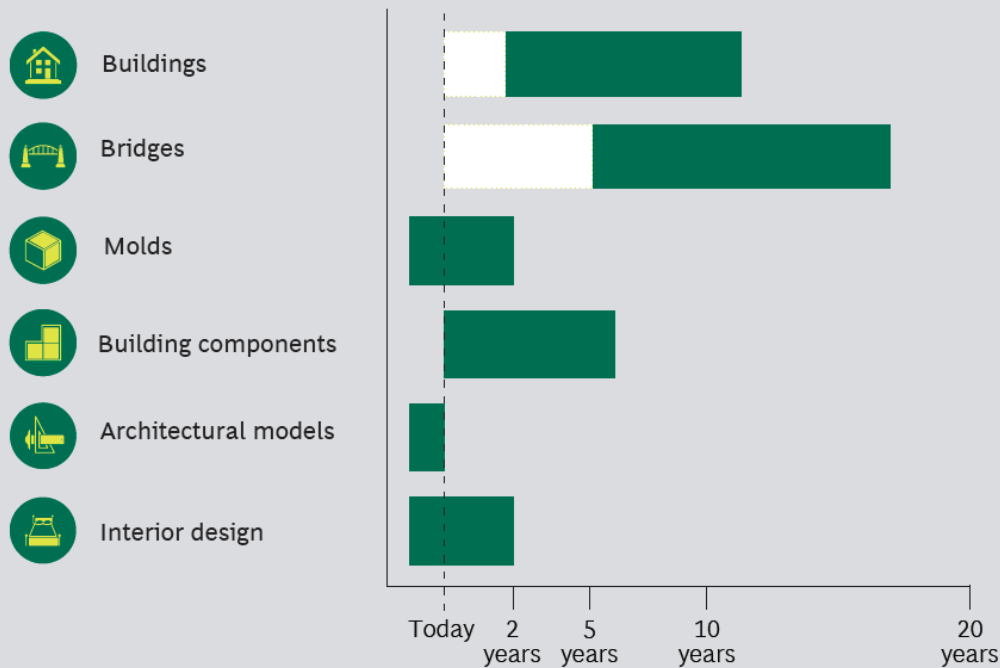
3DCP Urban furniture, the Netherlands

# 3D printed houses

## Concepts



### Some Applications Have Reached Commercial Viability

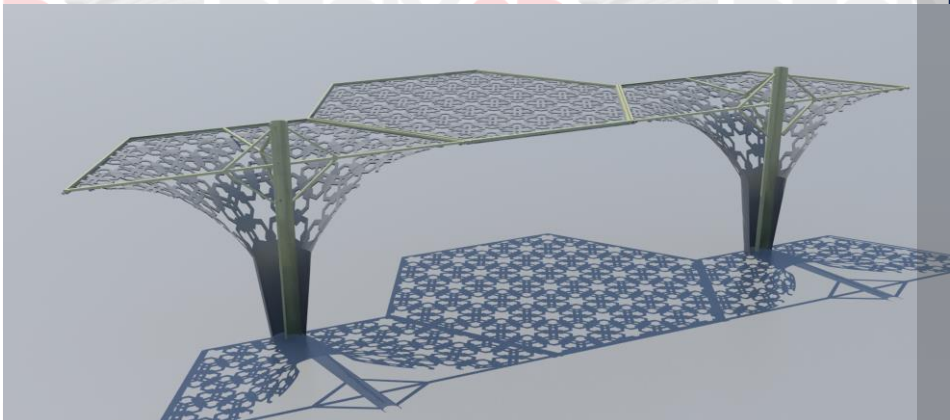
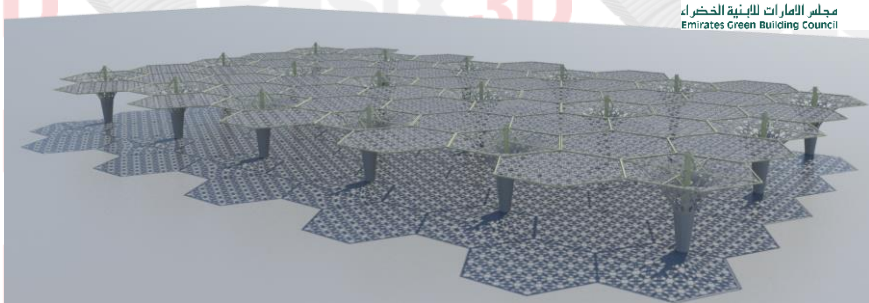


Source BCG, 2014



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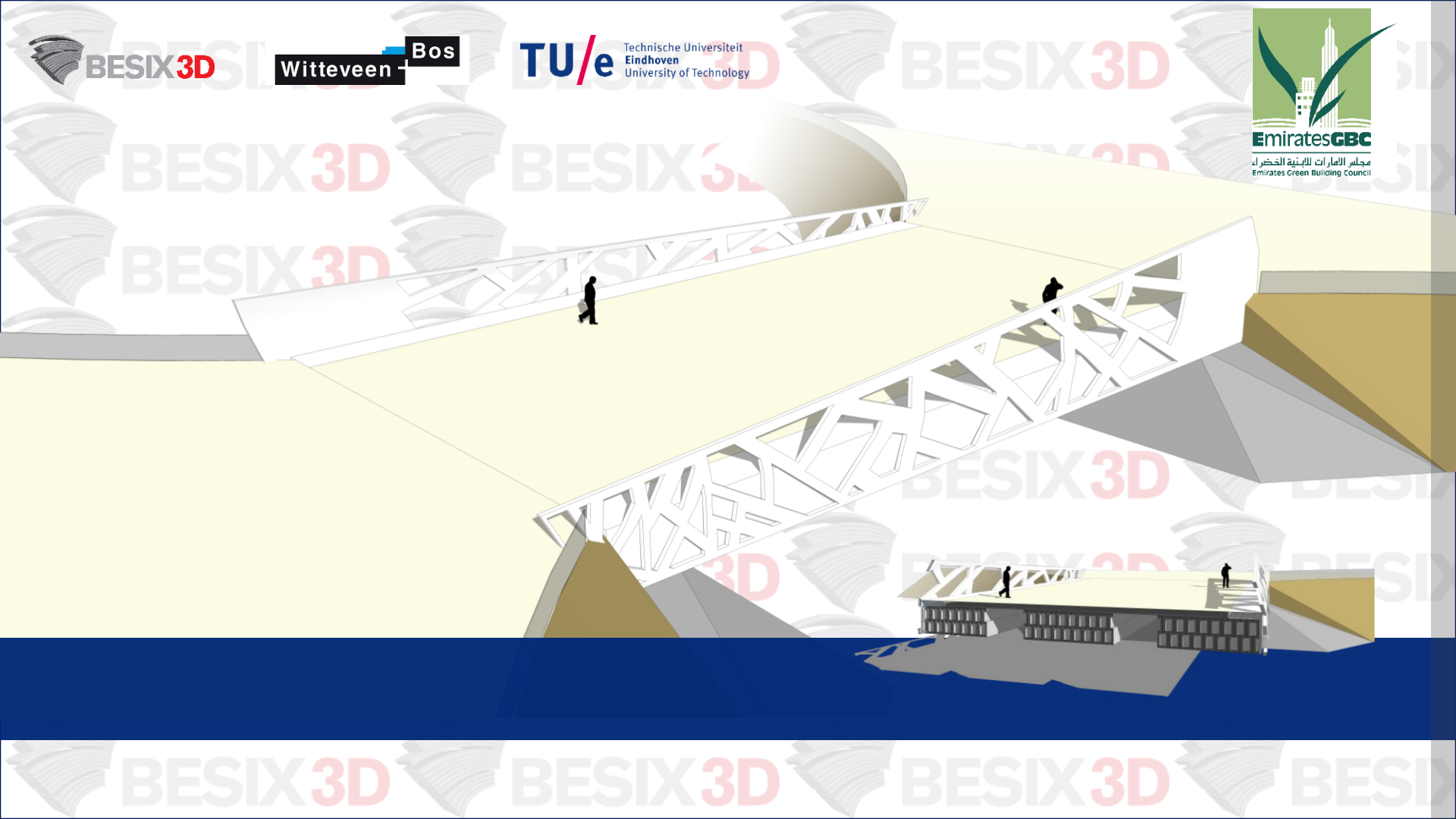
# TRACK RECORD





Witteveen + Bos

TU/e Technische Universiteit Eindhoven University of Technology



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# IN-HOUSE 3D CONCRETE PRINTING PRODUCTION FACILITY



# BESIX 3D STUDIO

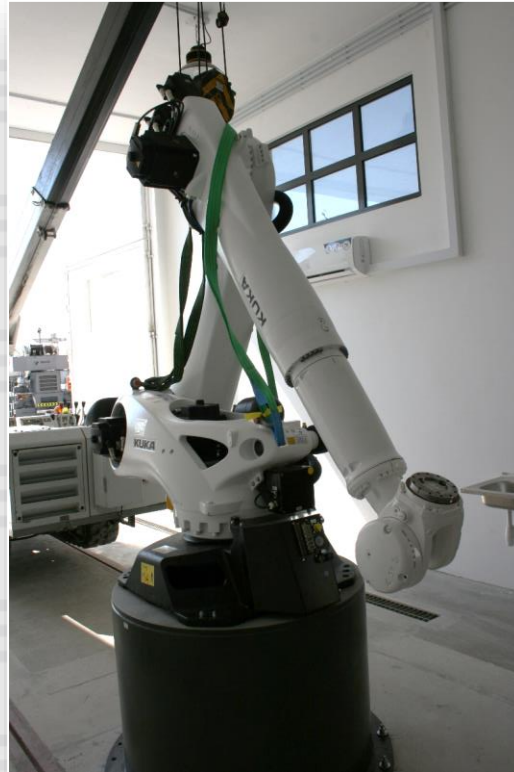
Dubai-based 3DCP production facility

- Dubai (Al Quoz)
- 120m2 dedicated facility
- State-of-the-art technology & equipment
- Together with world-leading partners



# BESIX 3D STUDIO

Dubai-based 3DCP production facility



# BESIX 3D STUDIO

Dubai-based 3DCP production facility



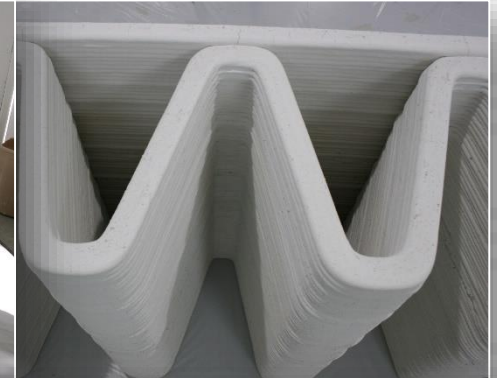
# BESIX 3D STUDIO

Dubai-based 3DCP production facility



# BESIX 3D STUDIO

Dubai-based 3DCP production facility



# BESIX 3D STUDIO

In-house 3DCP production facility



07/01/2018



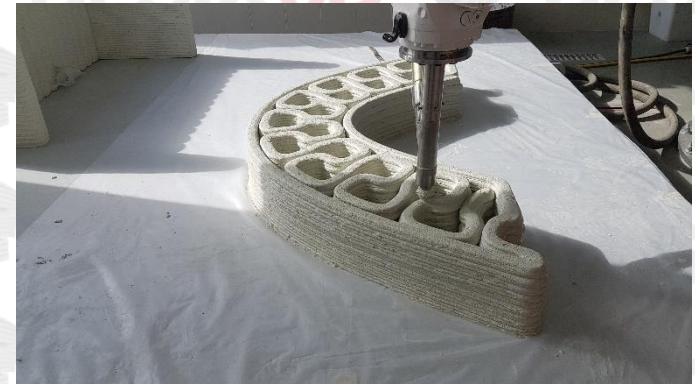
# BESIX 3D STUDIO

In-house 3DCP production facility



# BESIX 3D STUDIO

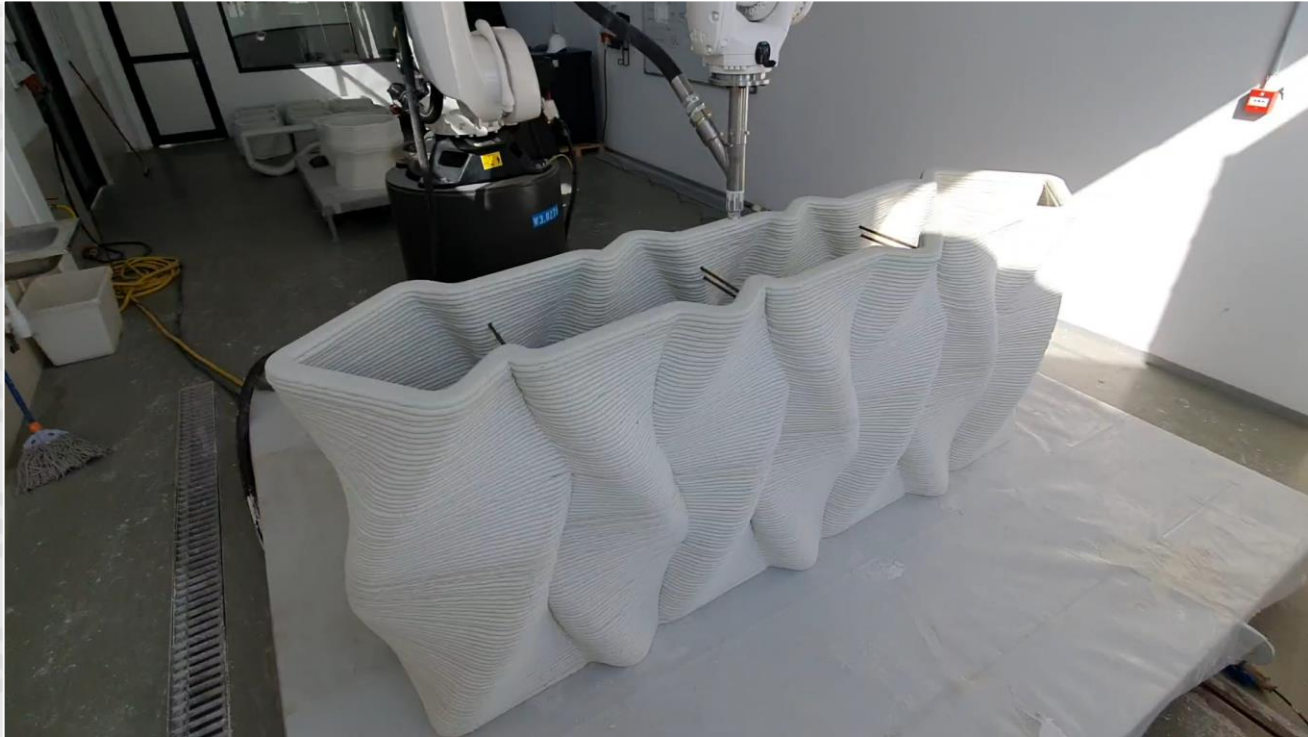
In-house 3DCP production facility





# BESIX 3D STUDIO

Dubai-based 3DCP production facility



# BESIX 3D STUDIO

The Woven Wall



# BESIX 3D STUDIO

The Stem Wall



# BESIX 3D STUDIO

## Outdoor Furniture



# BESIX 3D STUDIO

Planters



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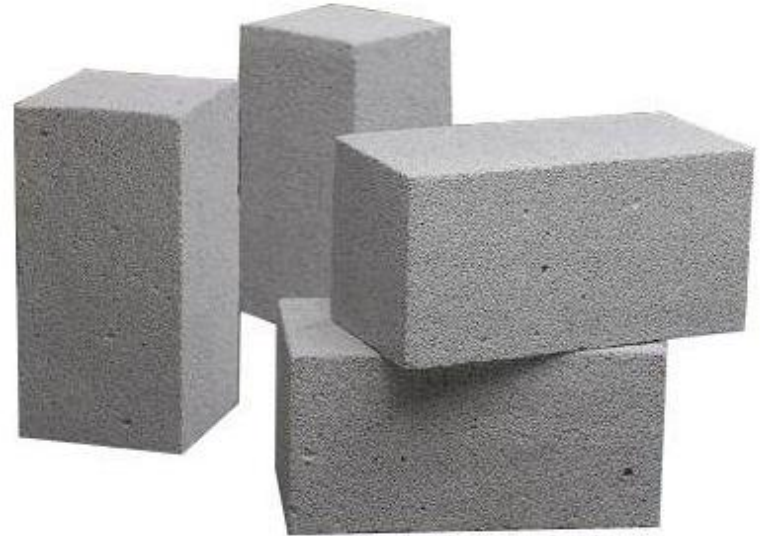
# 3D VS TRADITIONAL SUSTAINABILITY

# Sustainable materials and resources consumption

## 3D Concrete Printing method

Vs.

## Traditional methods



- ✓ Requires **50% less** amount of **concrete**
- ✓ Consists of **ready mixed powder** and **water**
- ✓ Consumes **30 L of water per 1m<sup>3</sup> of concrete**

- Requires **2 times more amount of concrete**
- Consists of **cement, aggregates, sand, water**
- Consumes **150 L of water per 1m<sup>3</sup> of concrete**

# Sustainable materials and resources consumption

## 3D Concrete Printing method

Vs.

## Traditional methods



- ✓ **No formwork** and **no curing compounds** – materials saving and waste reduction

- Casting concrete into a mould (formwork) **consumes plywood, timber, metal rebar, generates waste.**



# Benefits of almost no waste generation

## 3D Concrete Printing method



- ✓ Almost **no concrete waste** generated by using only the exact amount of material needed.

Vs.

## Traditional methods



- Leftovers of unused concrete, materials **wastage**, landfill void space occupancy

# Reduces Air Emissions and Noise

## 3D Concrete Printing method

Vs.

## Traditional methods



- ✓ **Electrical** installation
- ✓ **Low energy** consumption (1-3 kWh)
- ✓ **Zero dust** generation
- ✓ **Zero noise** generation

- Require operation of concrete mixer trucks, concrete pumps, diesel generators, and other equipment, working on diesel fuel – **air emissions**
- Generates **dust, noise**



# Soil and Groundwater protection

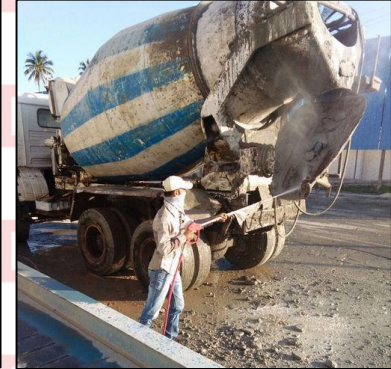
## 3D Concrete Printing method

Vs.

## Traditional methods



- ✓ **Clean** operation, eliminates risk of soil and groundwater contamination



- **High risk of soil and groundwater contamination**



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# BESIX 3D TEAM

# BESIX 3D team

We are ready



Management support



Jean Philippe  
Patesson

Strategic committee



Michael  
Eeckhout



Benoit  
Meulewaeter

Design & printing expert



Luai  
Kurdi

R&D programs



Johannes  
Anrijs

General lead

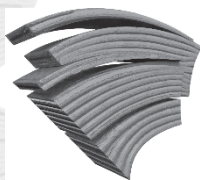


Jonas  
Vandeven

Operations



Paul  
Vanderhaeghen



# BESIX 3D



Thank You

