N3XTCON
WP4 DELIVERABLE

GANTRY-BASED PRINTER DEVELOPMENT

COBOD

DELIVERABLES FROM WP4

▶ Tracks solution - BOD3 Developments

▶ New tool base solution - Universal carriage for rapid tool changing

▶ Upgrade from mortar mixer and pump to concrete pump and batch mixer: our Dfab Solution

▶ New printhead – The new High-Througput (HT) printhead including dual dosing

▶ Tool application solution

   • Nozzle improvements

▶ Collision avoidance algorithm

BOD 3

BOD3 DEVELOPMENTS - KEY FEATURES

TRACK-BASED PRINTER SYSTEM

▶ Reusing as many components as possible between BOD2 and BOD3 for interchangeability, especially trusses and carriages

▶ New carriages specific to BOD3 are the Y-carriages, Z/X and top-bracket for attaching alu-truss

▶ As a track solution, COBOD trusses are used as rails with a purpose-built wheel system that easily attaches for setup and alignment

▶ Alignment of tracks is achieved by using our precision-made trusses

  • Cover terrain unevenness of up to 300mm

▶ Maximum size of a BOD3 configuration is 45m long, 12m wide and 10m tall

  • After this length, pumping concrete becomes more difficult, but is still possible

▶ A new hose management was developed that uses a drag chain + pipe solution

  • Majority of hoses now run on the ground inside cable chains (less weight on trusses)

  • The new system is specifically designed for DN75 hoses allowing for lower pumping pressure and larger aggregate size

▶ All printhead and accessories developed for BOD2 are able to fit on the BOD3

▶ A new cable bracing system from the Y-carriages to the top of Z-axes has been developed for additional stability

▶ To avoid the operator panel moving with the printer, an external e-box was developed to include all controls, chemical pumps and space for additional developments

BOD3 TEST IN THE FIELD

TESTING IN COPENHAGEN AND DELIVERED TO ANGOLA

▸ After developing and testing parts in our R&D lab, a full-scale version was set up in the summer of 2023

▸ The first customer version was then shipped to Angola where it is now printing for a customer

▸ Another 5 orders for BOD3 have been received and produced by COBOD

COBOD

UNIVERSAL CARRIAGE DESIGN

RAPID TOOL CHANGING

▶ COBOD have developed a quick-swap carriage where the lower section can be customised for different tools such as printhead, robotic arm, casting head, etc.
  - This has been named the "universal carriage"

▶ Produced in several iterations and delivered with all BOD3 machines

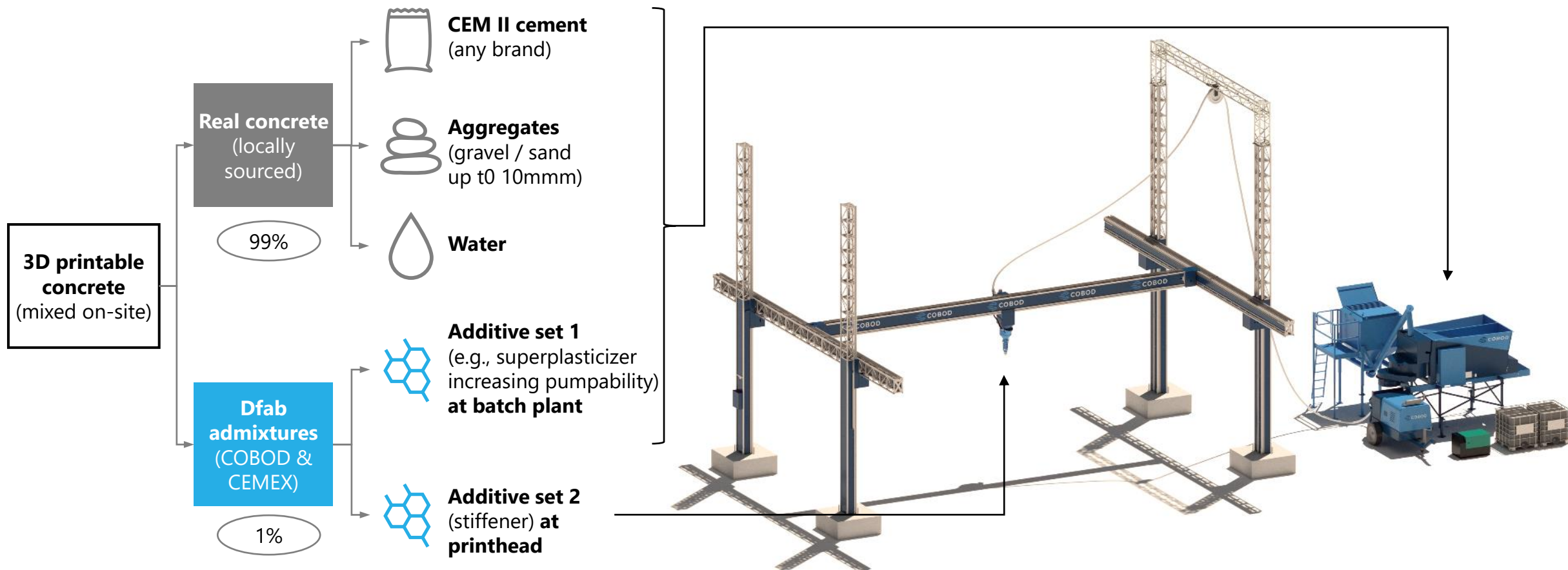▶ Tools can be swapped in less than 10 minutes using a special wheeled stand to transport the parts
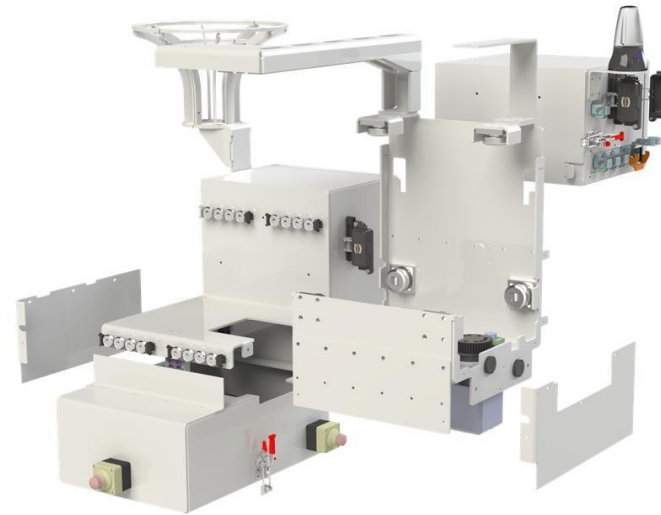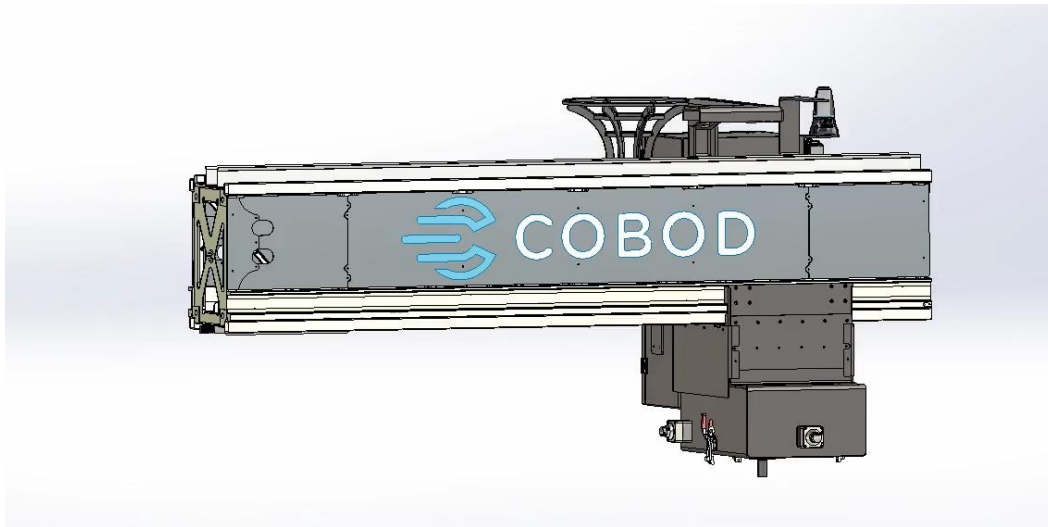
DFAB SYSTEM OVERVIEW

▶ Moving from mortar to concrete printing by using a new developed on-site batch plant and pump, and special additives

COMPONENTS BREAK-DOWN

BOD2 PRINTER AND CONCRETE BATCH PLANT

3D printable concrete (mixed on-site)

Real concrete (locally sourced) — 99%

CEM II cement (any brand)

Aggregates (gravel / sand up t0 10mmm)

Water

Dfab admixtures (COBOD & CEMEX) — 1%

Additive set 1 (e.g., superplasticizer increasing pumpability) **at batch plant**

Additive set 2 (stiffener) **at printhead**

COBOD'S CONCRETE PRINTING SOLUTION

PRINTING WITH REAL CONRETE

SILO 3m^3

CEMENT

GRAVEL >10mm

SAND >2mm

D.FAB

MINI BATCH PLANT

SAND >2mm

PUMP

WATER

CONCRETE

PRINTHEAD DEVELOPMENTS

2K PRINTHEAD

▶ COBOD upscaled from mortar to concrete printing with local materials using our Dfab solution, batchplant and concrete piston pump

▶ The introduction of additives required a redesign of our printhead to allow injection of chemicals right before extrusion

▶ New HT printhead developed for high-throughput with larger volume, bigger nozzles and improved tangential control

▶ Inlet to hopper increased from 2" to 4" from original mortar printhead, new printhead can now print with fibres and is suited for DN75 hoses – potentially moving to 16mm aggregate size concrete
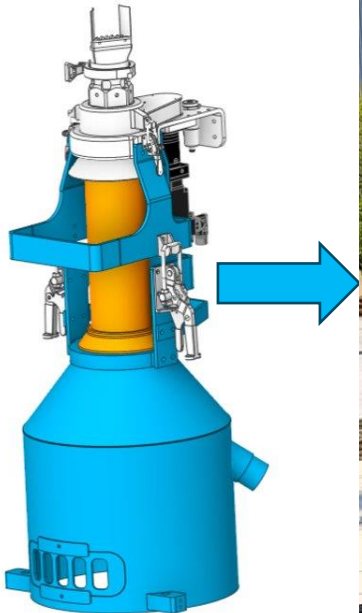
Fibre-reinforced concrete FRC

TOOL APPLICATION - SMOOTH WALLS

NOZZLE IMPROVEMENTS

▶ One of the main challenges is to create walls that look like precast elements

▶ A lot of work being done on nozzle design, flaps and additional chemical additives to improve surface quality

COLLISION AVOIDANCE ALGORITHM

DEVELOPED AS PART OF N3XTCON WITH SDU

▶ A monitoring system has been developed that tracks the built geometry as the printer prints layers.

▶ This creates a digital twin of the existing building virtually, allowing the software to check for collisions

▶ By continously monitoring the position of the printhead, the algorithm can detect if a collision is imminent and stop the printer from moving

▶ Furthermore, control of the printer has been set up allowing an operator to easily move the printhead in all directions using a game controller

▶ The framework has been tested on a BOD2 and a BOD3 printer and demonstrated that the collision avoidance algorithm works
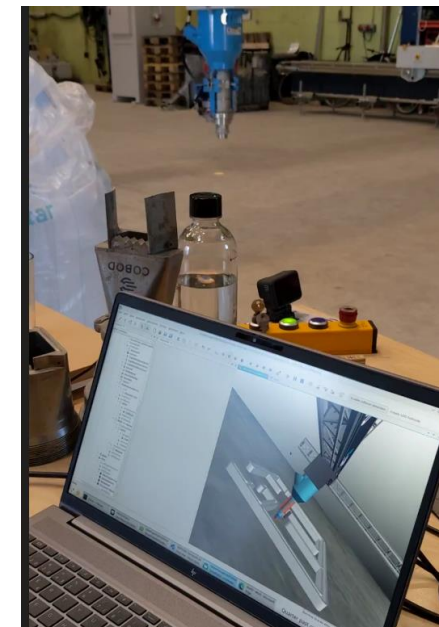
Without avoidance, triggering e-stop

With avoidance – the printer cannot move into the wall

Remote control with gamepad