

COBOD INTERNATIONAL

3D CONSTRUCTION PRINTING TECHNOLOGY

COBOD CONNECT November 26th, 2024



The event will be recorded.

Use the Q&A feature to ask questions during presentations, followed by a brief Q&A session after each.



WELCOME & INTRODUCTION

Welcome to our COBOD Connect Event!

Join us for our biannual meeting to celebrate our joint accomplishments and discover the latest innovations at COBOD.

We'll dive into customer projects and introduce our new products. Interactive sessions and demos await, along with the chance to discuss your ideas with peers.

Prepare for an insightful and productive session ahead!

COBOD Participants



Henrik Lund-Nielsen
Founder & General Manager



Zoë A. C. Knudsen
Head of Products & Communication



Simon Klint Bergh
Co-Founder & Head of APAC

Guest Speakers

3DCP
GROUP

 **Modula
Tiga
Dimensi**

 **ABYAN**
HTL
TECH

AGENDA

Timing*	Topic	Presenter
09.00 - 09.15	State of the Union	Henrik Lund-Nielsen
09.15 - 09.25	3DCP Group presentation	Mikkel Brich
09.25 - 09.35	Advancements and Further Developments	Henrik Lund-Nielsen
09.35 - 09.55	Modula3D presentation	Pak Adi
09.55 - 10.05	Analytical Project Feedback	Simon Klint Bergh
10.05 - 10.35	Innovations and New Applications	Henrik Lund-Nielsen Zoë A. C. Knudsen
10.35 - 10.50	Abyan presentation	Ahmad AlNaseem
10.50 - 11.00	Q&A	Henrik Lund-Nielsen Zoë A. C. Knudsen

*Central European Time (CET)

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3DCP MARKET DEVELOPMENTS

The Market In 2024

- ▶ Rising interest rates in 2023 slowed new projects in Europe and the US.
- ▶ 2024 shows recovery in infrastructure, industrial, and utility sectors.
- ▶ Broader adoption of 3DCP technology across non-residential applications.

Expanding Applications and Larger Projects

- ▶ Growth in social housing, offices, utilities, and infrastructure (e.g., water tanks, coastal barriers).
- ▶ Optimized geometries reduce material use, costs, and CO2 emissions.
- ▶ Larger-scale projects now include multi-building sites, demonstrating scalability.

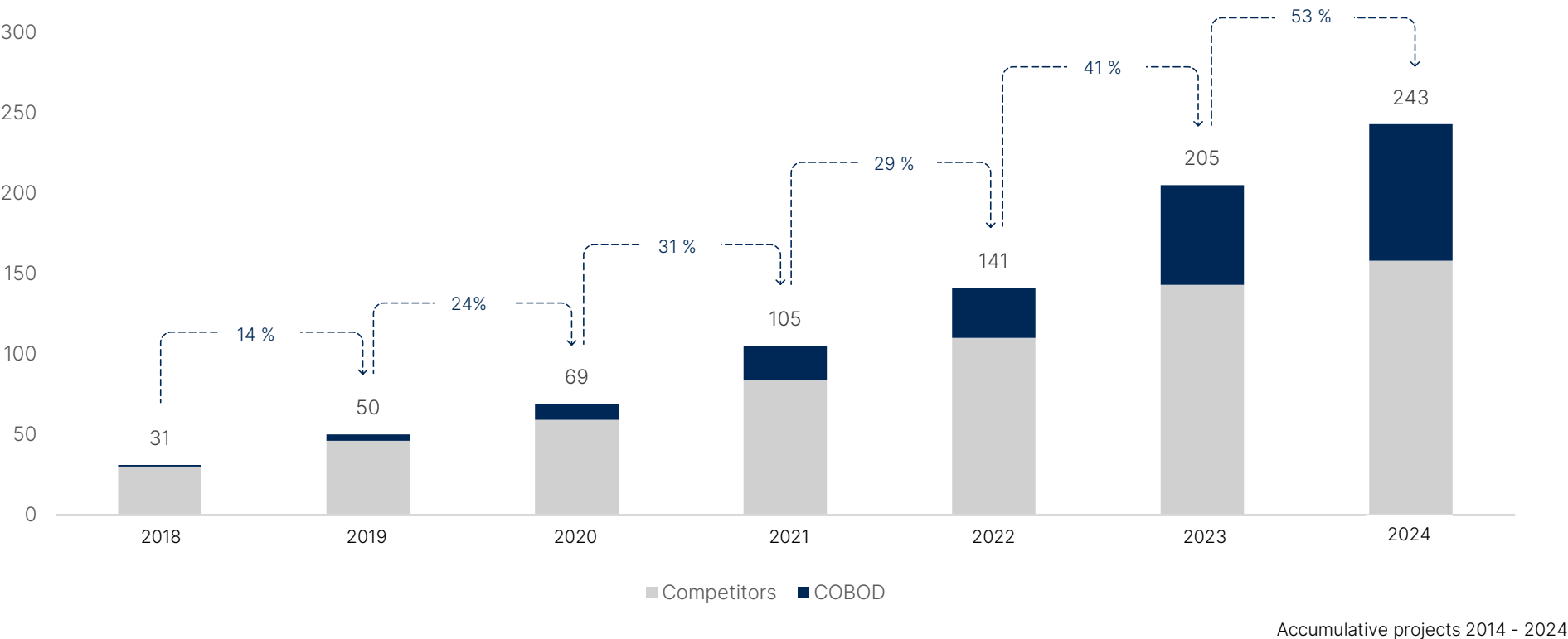
Design Freedom and Sustainability

- ▶ 3DCP surpasses traditional methods with precise, optimized designs.
- ▶ Applications include coastal barriers and wind turbine towers.
- ▶ Significant material and CO2 savings reinforce 3DCP's sustainability.

GLOBAL GROWTH IN 3D PRINTING PROJECTS

A CLOSER LOOK AT THE NUMBERS DRIVING ADOPTION WORLDWIDE

With the growing adoption of 3D construction printing across diverse applications, the industry has seen a significant rise in the number of 3D printed projects worldwide. This upward trend reflects the increasing trust in the technology's scalability, efficiency, and sustainability.

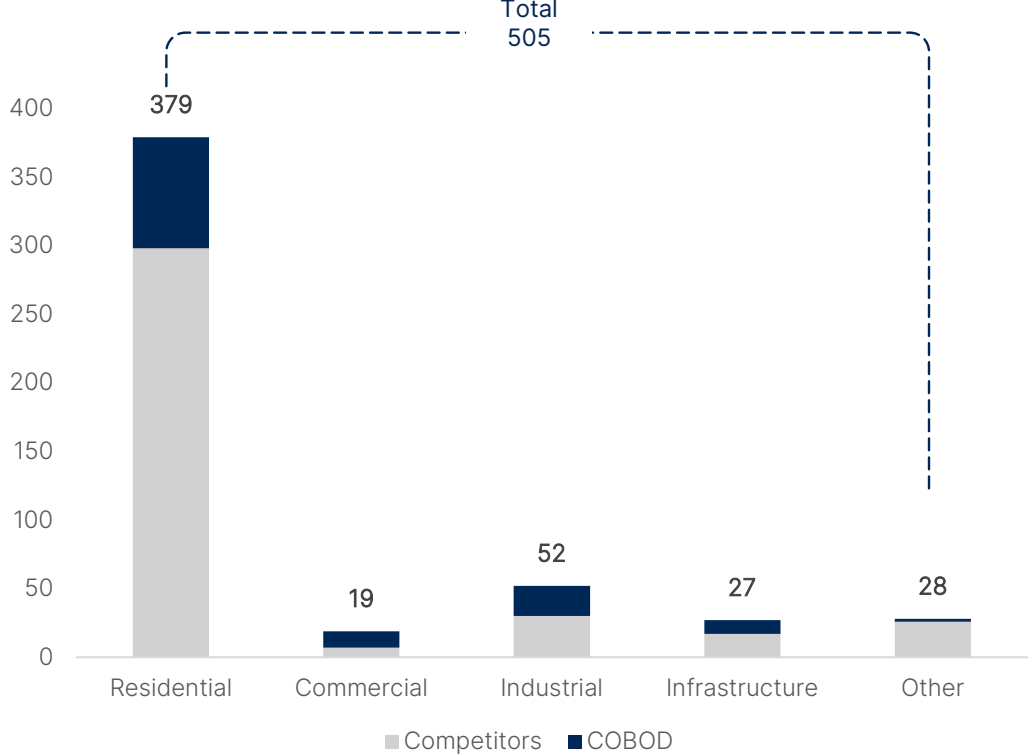


COBOD IN 2024

As 3D construction printing continues to evolve, its impact is expanding beyond residential projects, which has been the main application area for 3DCP in many years. Now, we experience a move into more commercial and industrial applications. Also, exemplified based on the UCC order we just received, our largest order yet, so it is fair to say that the residential sector won't be the leading application area for much long as other sectors are increasingly recognizing the advantages of 3DCP.

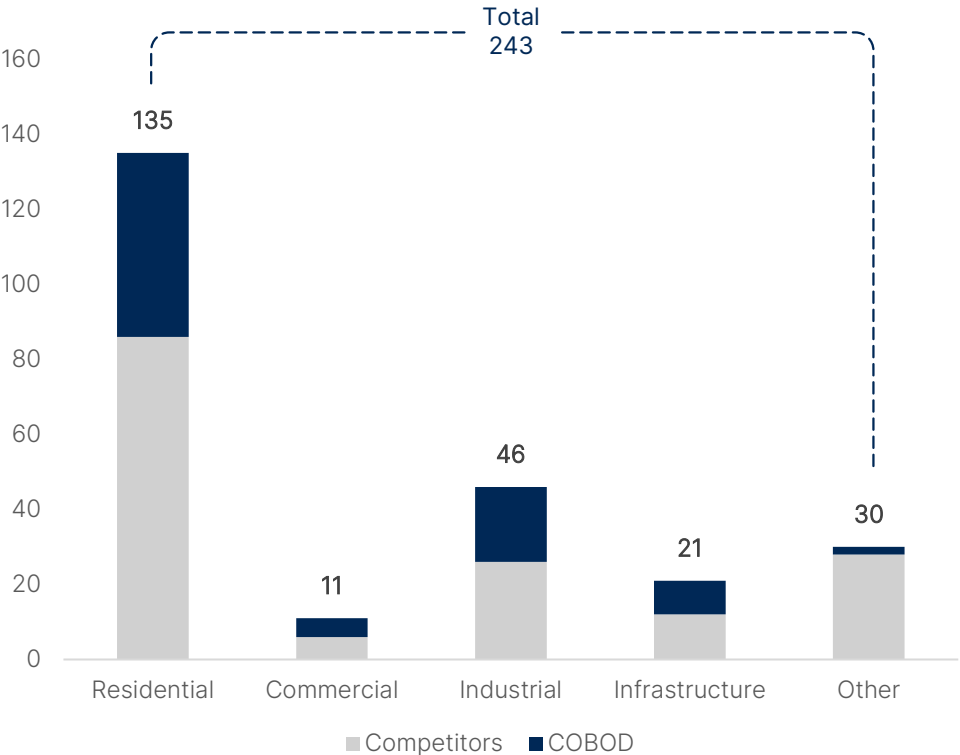
Buildings (incl. Units) Up to 2024

accumulated numbers



Projects Up to 2024

accumulated numbers



NEW PROJECTS (1/2)



UCC School Project

Location: Qatar

Project Size
40.000 sqm (20.000 sqm per building)

Design Focus
Environmental integration

Project Status
L2 training is currently being performed



Grange Close Project (HTL)

Location: Dundalk, Ireland

Project Size
330sqm (110 sqm per unit)

Print time: 12 days

Project Status
Near completion and first building to comply with the rigorous new I.S EN ISO/ASTM 52939:2023 additive manufacturing standard



Water Tank Project

Location: Barczewo, Poland

Project Size
7.5m (diameter) and 7m tall

Print time: 38 hours

Project Status
Successfully completed and impressive material savings of 25%

NEW PROJECTS (2/2)



3DCP GROUP

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THE BOD3 IN ACTION



- ▶ 6 units sold before official launch
- ▶ 6 already delivered
- ▶ 2+ machines are active already in ongoing projects

The BOD3 Post-Launch Update

Since the launch, all 6 pre-ordered BOD3 units have been delivered and the majority are already being used in projects. Modula3D, one of our first BOD3 clients, is showcasing the capabilities of the BOD3 in their latest project, as seen in the video.

The extendable track system makes the BOD3 ideal for multi-building sites, reducing setup time and increasing efficiency. This feature is perfect for scaling up operations across larger projects.

BOD3 KEY FEATURES

TRACK-BASED PRINTER SYSTEM

- ▶ Reusing as many components as possible between BOD2 and BOD3 for interchangeability
- ▶ Alignment of tracks is achieved by using our precision-made trusses with adjustable feet
 - ▶ Cover terrain unevenness of up to 300mm
- ▶ Maximum size will be 45m long, 12m wide and 10m tall
- ▶ Hose management will use a drag chain + pipe solution
 - ▶ Majority of hose will run on ground
 - ▶ Designed for DN75 hoses
- ▶ All printhead and accessories from BOD2 will be able to fit on BOD3
- ▶ Cable bracing from Y-carriage to top of Z developed for additional stability





MODULA3D

ANALYTICAL PROJECT FEEDBACK

OPPORTUNITY TO IMPROVE YOUR PROJECT PRODUCTIVITY

FEEDBACK ON DAILY PRINTING REPORT

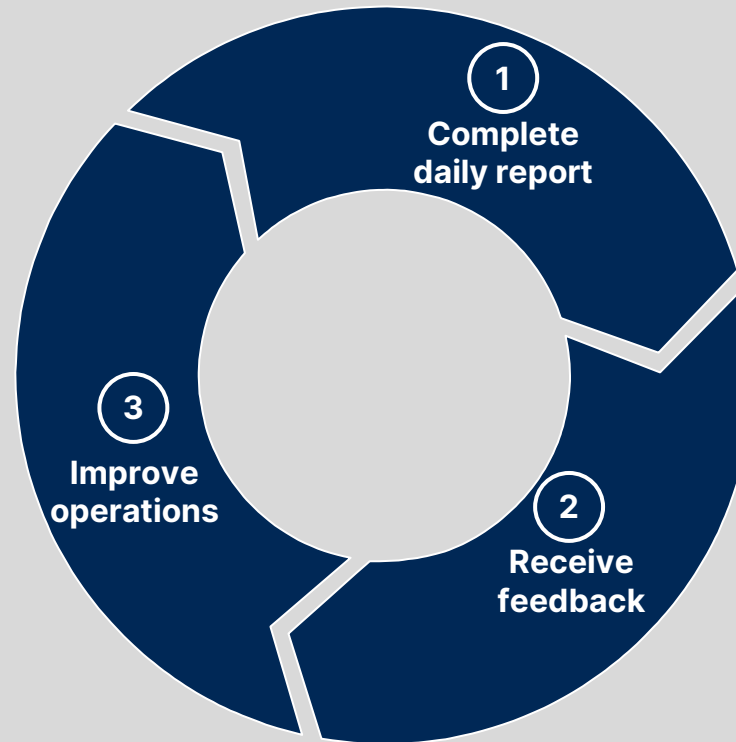
What and why

Our goal is to enhance both the technology and its application, working alongside you to achieve better results through a feedback cycle.

Construction sites, including 3DCP, often encounter various challenges, but **with COBOD's extensive expertise and experience with global clients, we can help address these issues more quickly** and effectively than if you were to tackle them on your own.

Participation is completely free of charge and takes only a few hours weekly.

How – the improvement cycle



Fill out daily report and share with COBOD (site manager or operators), e.g., layers, start/stop time, material waste, etc.

Engage in a discussion with the expert team to identify potential improvements, such as addressing challenges related to materials, troubleshooting, and other key issues.

EXAMPLE PROJECT IMPROVEMENTS (1/2)

SEAPI PROJECT, INDONESIA – DAILY REPORTS

Print Data Collection

Daily Printing Report

Project Name: SEAPI Project **Report by:** KF, BST

Unit type and Number: (VIP1, VIP2, S1, S2, S3, S4, M1, M2, CH1, CH2, CH3, Patio1, Patio2)

Date: 14/07/2024 **Nozzle Type:** 50x40mm Bendy

In order to structurally learn from on-site printing so we can improve both technology and as onsite teams, data from the specific on-site printing days are super important. Please fill in this document on a daily basis and upload it to our shared folder: [Daily Printing Reports - SEAPI Project](#)

The data will be used to:

- Improve overall efficiency on site
- Understanding cost measures for the specific building
- Improving technology and use going forward.

NB: THIS IS NOT A PERFORMANCE MEASURE INDIVIDUALS WILL BE EVALUATED ON – ONLY FOR PRINTING AND TECHNOLOGY PROGRESS UNDERSTANDING AND EVALUATION

Comments for the day – Printing: (How did it go overall – Positive and negative? Any stops due to: Printer issues, Operation issues or other?)

Today's printing process went smoothly overall, despite encountering several challenges. We managed to print up to layer 11 (44 cm), since plumbing installation required at layer 12.

Stops were necessary at the following points:

- Material Issues:** In the early layers, there was a stop due to the material being too liquid caused by a leak at the dosing stiffener additive connector on the print head.
- Socket Installation:** Stops occurred during the installation of electrical sockets in the living room and TV at layers 7 and 8. Material dried out after a prolonged stop (10 minutes), causing a blockage in the nozzle flow, required a pause to remove the material before continuing.
- Nozzle Cleaning:** There was a stop for cleaning the nozzle to address dried material. Afterward, we encountered issues with the U-axis movement, with the nozzle shifting angles (30°, 90°, and 180°) during transitions between walls. This was initially resolved by resetting the U-axis; however, the problem occurred approximately four times per layer, requiring us to reset the U-axis again each time.

Overall, despite these challenges, today's printing results were satisfactory, although not entirely meeting our expectations.

COBOD Asia Pacific Sdn Bhd
Lot 886, CT, Jalan Subang 9, 47500
Subang Jaya, Selangor, Malaysia
CVR-NR: 38151886

cobod.com/contact
+45 9290 9066
info@cobod.com

Comments for the day – Material (please further upload all material recipes): (How did it go with batching and material consistency throughout the day – any key learnings (positive or negative)?)

Today, the material was prepared in 9 batches, each sized at 0.2 m³, totaling 1.8 m³. The resulting material have a shear vane value in the range of 9-10, consistent with yesterday's printing, using the same recipe and mix load.

In the first four layers (5-8), the material consistency was good. However, after layer 8, we encountered inconsistencies that required adjustments during printing. Some material was excessively dry, causing interruptions in the flow from the nozzle, while other material was too liquid, resulting in over-extrusion.

Overall, the material met the printing size requirements, despite the inconsistency observed in the final three layers.

Recipe overview				
Recipe name:	Recipe Bragi Lampung		Recipe	11
Aggregate	Material			Stop
Silo 1	Cement 1	653.25 kg	1	
Cement 1	Cement 1	455.00 kg	2	
Silo 2	Silo 2	857.14 kg	3	
Water 1	Water 1	195.00 l	4	
Chemical 1	Chemical 1	6.75 l	5	

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cobod.com/contact
+45 9290 9066
info@cobod.com

Date: 14/07/2024

Data point	Value	note (if any)
Print-day number [#]	2	
Number of Layers done [#total, first layer, last layer]	7, 5, 11	
Site arrival time [HH:MM]	11:00	We have a lunch break from 12.30 until 14.00
Printing start time [HH:MM]	15:00	
Printing stop time [HH:MM]	17:45	
Site left (after cleaning) [HH:MM]	23:00	
Time stopped total (during printing): [min]	45 min	
Material Use [m3]	1.8 m³	
Material Wastage [m3]	0.2 m³	
Number of Batches [#]	9	
Other traits active (Electrical, plumbing etc.)	Electrical, Socket, Wall Binders	
Number of Operators on site (printing) [#]	2	1 PO, 1 MO
Number of Workers on site (printing) [#]	7	6 Workers, 1 Forklift Operator
Weather [Min Temp, Max Temp, Rel Humidity, sun/cloud/rain]	29°, 30°, 70%, Sun	
Diesel or Electricity used [l or kWh]	35 l	
Water consumption [l or m3 – please specify]	4500 l	
Water Temperature (inlet) [Degrees C]	29°	
Any stop of print due to Materials? [#] – please add note		Material Inconsistency
Any stops of print due to Printer? [#] – please add note		Socket Installation, Material inconsistency, Nozzle Cleaning

COBOD Asia Pacific Sdn Bhd
Lot 886, CT, Jalan Subang 9, 47500
Subang Jaya, Selangor, Malaysia
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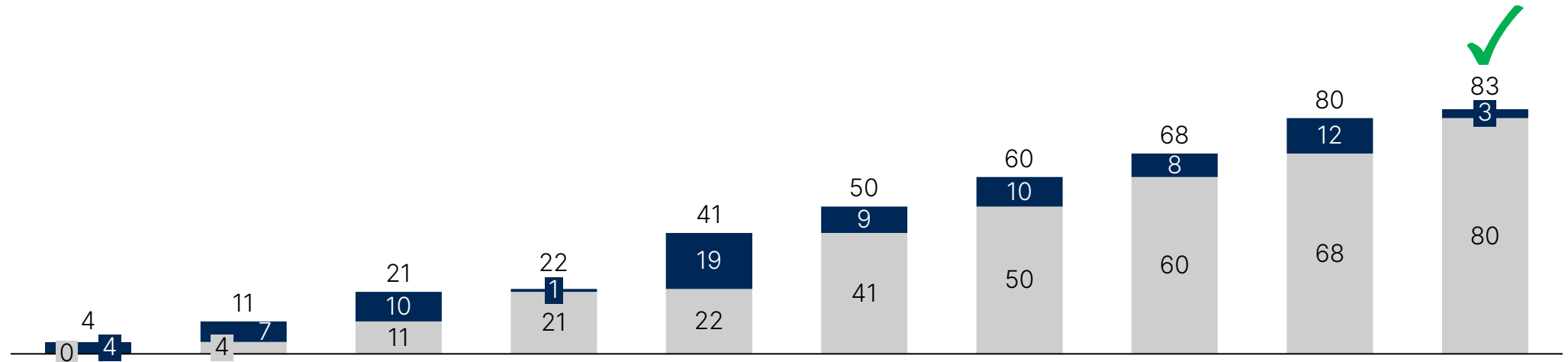
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EXAMPLE PROJECT IMPROVEMENTS (2/2)

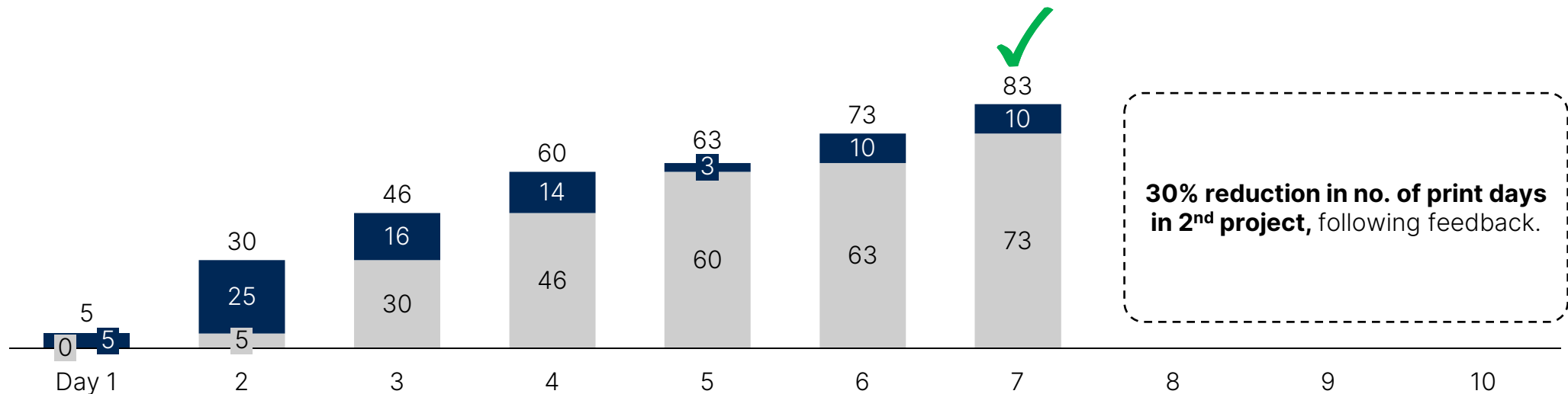
SEAPI PROJECT, INDONESIA – LAYERS PER DAY

■ Printed that day
■ Printed previous days

House #1



House #2



LET'S IMPROVE TOGETHER

If you are interested, please contact your local COBOD representative




Print Data Collection Daily Printing Report

Project Name: SEAPI Project **Report by:** KF, BST
Unit type and Number: VMP1, VMP2, S1, S2, S3, S4, M1, M2, CH1, CH2, CH3, Patio, Terrace
Date: 14/07/2024 **Nozzle Type:** 50x40mm Bendy

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The data will be used to:

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- Nozzle Cleaning: There was a stop for cleaning the nozzle to address dried material. Afterward, we encountered issues with the U-axis movement, with the nozzle drifting angles 150°, 50°, and 180° during transitions between walls. This was initially resolved by resetting the U-axis; however, the problem occurred approximately four times per layer, requiring us to reset the U-axis again each time.

Overall, despite these challenges, today's printing results were satisfactory, although not entirely meeting our expectations.









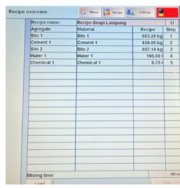



Comments for the day - Material (please further upload all material recipes): *(How did it go with batching and material consistency throughout the day - any key findings, issues or remarks?)*

Today, the material was prepared in 9 batches, each sized at 0.2 m³, totaling 1.8 m³. The resulting material have a shear vane value in the range of 8-10, consistent with yesterday's printing, using the same recipe and mix load.

In the first four layers (S all), the material consistency was good. However, after layer 8, we encountered inconsistencies that required adjustments during printing. Some material was excessively dry, causing interruptions in the flow from the nozzle, while other material was too liquid, resulting in over extrusion.

Overall, the material met the printing size requirements, despite the inconsistency observed in the final three layers.





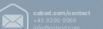





Date: 14/07/2024

Date point	Value	note (if any)
Print-day number [P]	2	
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Material Wastage [m³]	0.2 m³	
Number of Batches [P]	9	
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Number of Workers on site (printing) [P]	7	6 Workers, 1 Forklift Operator
Weather (Min Temp, Max Temp, Rel Humidity, Sun/cloud/rain)	29°, 30°, 70%, Sun/cloud/rain	
Cloud or Electricity used [l or kWh]	35 l	
Water consumption [l or m³ - please specify]	4500 l	
Water Temperature (inkjet) (Degrees C)	29°	
Any stop of print due to Materials? [P] - please add note		Material inconsistency
Any stops of print due to Printer? [P] - please add note		Socket installation, Material inconsistency, Nozzle Cleaning



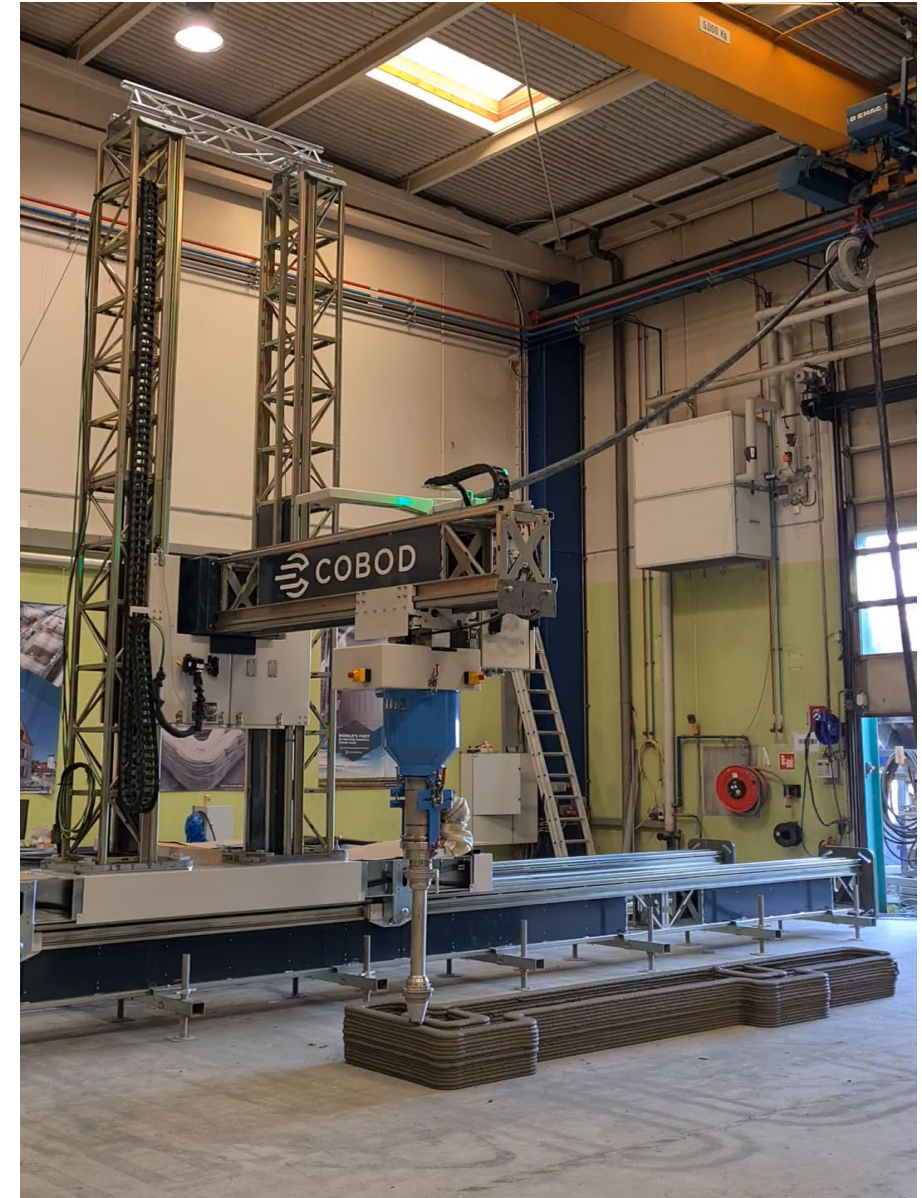


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BOD3 INFINITY

Our latest model has not been officially launched yet due to the focus on the BOD3. However, the BOD3 Infinity is set to debut in 2025.



BOD3 USED FOR WAREHOUSE AND DATACENTER APPLICATIONS

BOD3 Infinity <

2-2-2

Width (X) 2 Modules 2.0 m

Length (Y) 2 Modules 19.5 m

Height (Z) 2 Modules 8.9 m

- 3D print a building
- Printer options
- Settings
- Import 3D model
- Contact form
- About
- Reset

Printable area

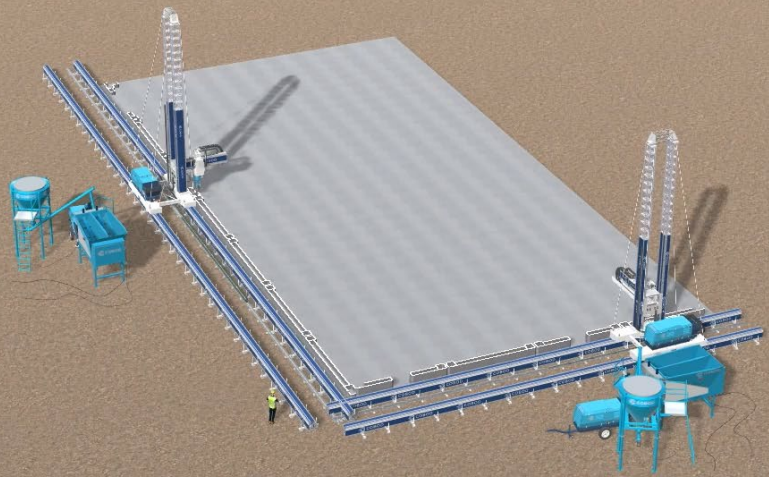
Floor count: 3 Floors

Floor area: 39 m²

Total area: 116 m²



Configurator V3.18 Beta



100% Printed

0% Printed

Nozzle focus

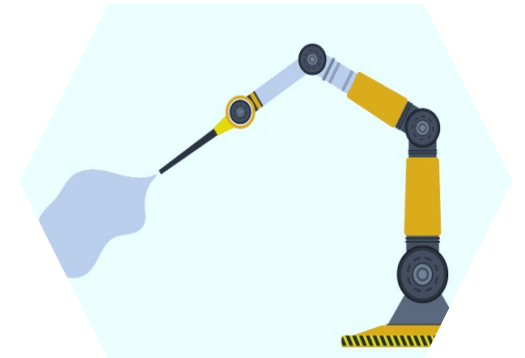
Print speed 4858300 mm / second

Playback controls

Navigation icons: Home, Previous, Play/Pause, Stop, Next

ROBOTIC ARM UPDATE

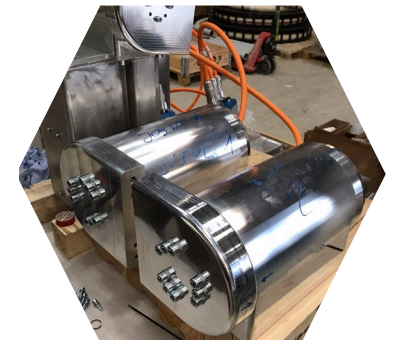
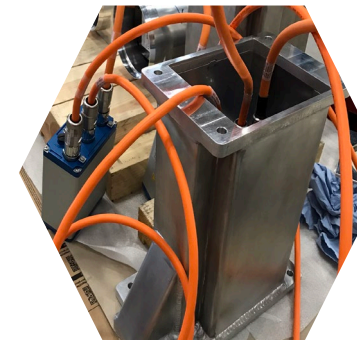
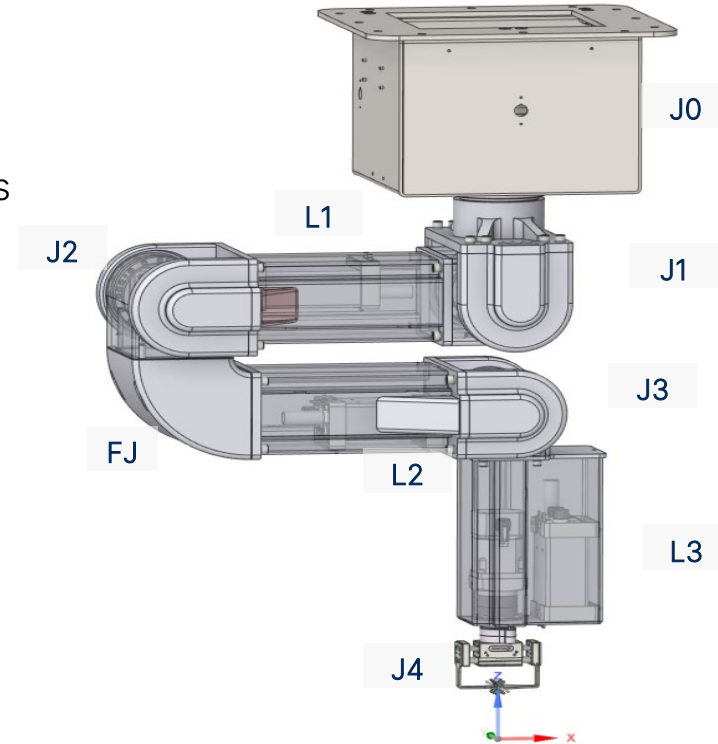
- ▶ Multi-functional robotics means being able to print more than just walls
- ▶ COBOD's mission is to automate at least 50% of all construction tasks
- ▶ Placing wall ties, spray painting, plastering and shotcreting are some of the intended applications
- ▶ COBOD looked at the market for industrial robots but found several barriers to adoption
 1. Closed control systems
 2. Not IP67 rated
 3. High weight with low payloads
- ▶ As a consequence, we decided to make our own robotic arm to have full control and to enable us to make modular arms, suiting different applications and customer needs.
- ▶ Through 2023, this was designed, prototyped and delivered as part of two university collaborations, who are now testing the robotic arms for their applications.



COBOD ROBOTIC ARM

DEVELOPMENT HIGHLIGHTS

- ▶ Developed to fit our customers' need – full control of all servo motors
- ▶ First model is a 5-joint robotic arm
- ▶ Reach: approximately 1.2m
- ▶ Payload: 25kg
- ▶ All links are in aluminum and sealed to IP67
- ▶ Drivers and motors fully integrated in the links and joints.
- ▶ Modular philosophy:
 - ▶ Make joints for specified torques
 - ▶ Links can be made adjustable
 - ▶ Can be controlled through G-code



WE PROMISED THE PRINTHEAD 2.0

We previously announced the development of the Printhead 2.0, featuring an integrated cleaning solution. This system was designed to streamline maintenance with high-pressure cleaning nozzles built into the hopper, allowing quick flushing of the system. Additionally, it includes a water supply system for sites with limited access to mains water, and control capabilities through a PLC for enhanced automation.

The Printhead 2.0 also introduces several innovations:

Separate Components

With the mixing arms and extruder screw now separate, operators gain finer control for a more consistent and manageable concrete mix.

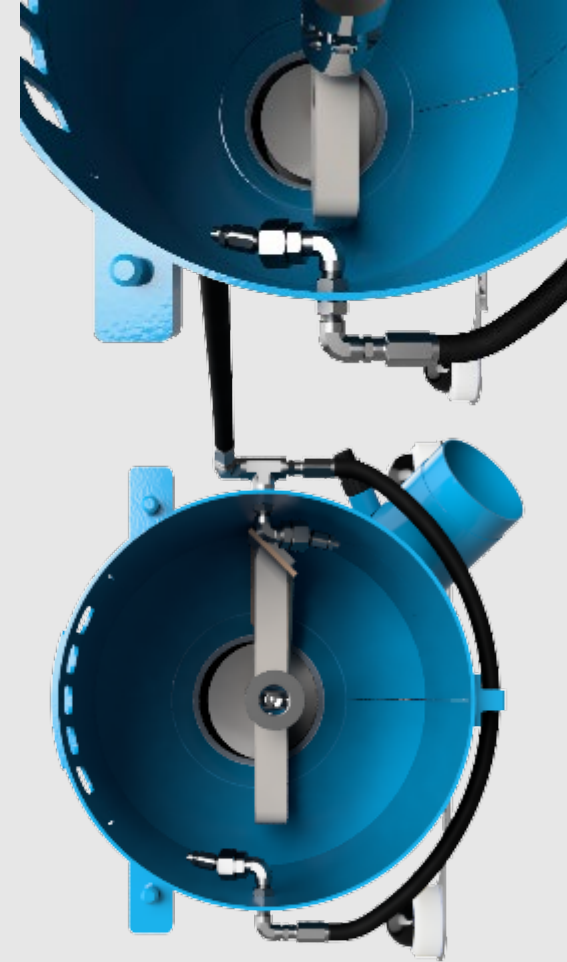
Additive Spraying System

Ensures a homogeneous mix, improving the material output quality.

Integrated Cleaning System

Simplifies maintenance with quick and efficient cleaning directly in the printhead.

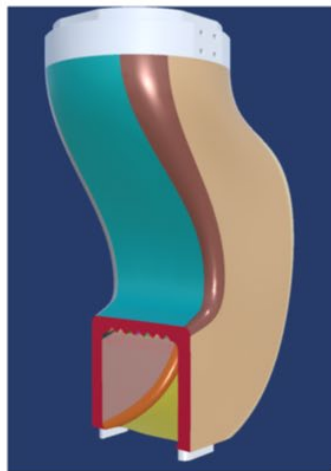
However, due to the substantial UCC order that required significant reallocation of our resources, development has been delayed. While we are always optimistic and aim high, we had to face the reality that we cannot do everything at once. However, we still see immense potential in this solution and therefore, we remain committed to delivering this.



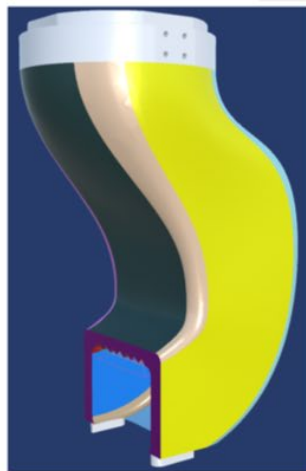
INTRODUCING OUR NEW "BENDY" NOZZLE

OUR "BENDY" DESIGN FOR ENHANCED SURFACE QUALITY

- ▶ A major technical hurdle is achieving smooth walls with low cement content – not just relying on additional paste to make the surface smooth
- ▶ We've tested a lot of different geometries and we have now found a design that achieves exactly that.



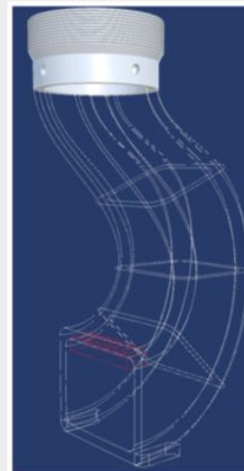
100x100 (Industrial)



100x80 (Industrial)



100x100 (HT)



100x80 (HT)



BENDY NOZZLE RESULTS

Customer 1

Customer 2

PERI

Standard



“Bendy”



COBOD BENDY CONFIGURATOR

To enhance rapid availability and customization of our Bendy nozzles, we've developed proprietary software that streamlines the process. Our new Bendy Configurator supports nozzles for both mortar machines and concrete machines, allowing you to customize the following parameters to meet your needs:

- Sizes
- Geometry
- Output shaping
- Curvatures

The "Bendy" design is specifically engineered to improve surface quality by delivering a more precise and controlled material flow. This results in smoother finishes and reduced need for post-processing, making it an essential tool for achieving superior project outcomes.

Once configured, you can 3D print the nozzles yourself, ensuring quick access and adaptability.

The Bendy Configurator will launch early next year for customers who purchase our COBOD Software Suite or choose a specific service package.





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COBOD INTERNATIONAL A/S

Skudehavnsvej 17A
2150 Nordhavn
Denmark
(+45) 9290 9066
info@cobod.com

COBOD NORTH AMERICA, INC.

228 Park Avenue South, #300
New York, NY 10003
USA
+1 (844) 384-4351
americas@cobod.com

COBOD ASIA PACIFIC SDN BHD

Jalan Lagoon Selatan
47500, Subang Jaya, Selangor
Kuala Lumpur, Malaysia
+60 19348 2234
apac@cobod.com

COBOD MIDDLE EAST & AFRICA

Under establishment
mea@cobod.com

KEY SHAREHOLDERS



COBOD.COM/CONTACT

