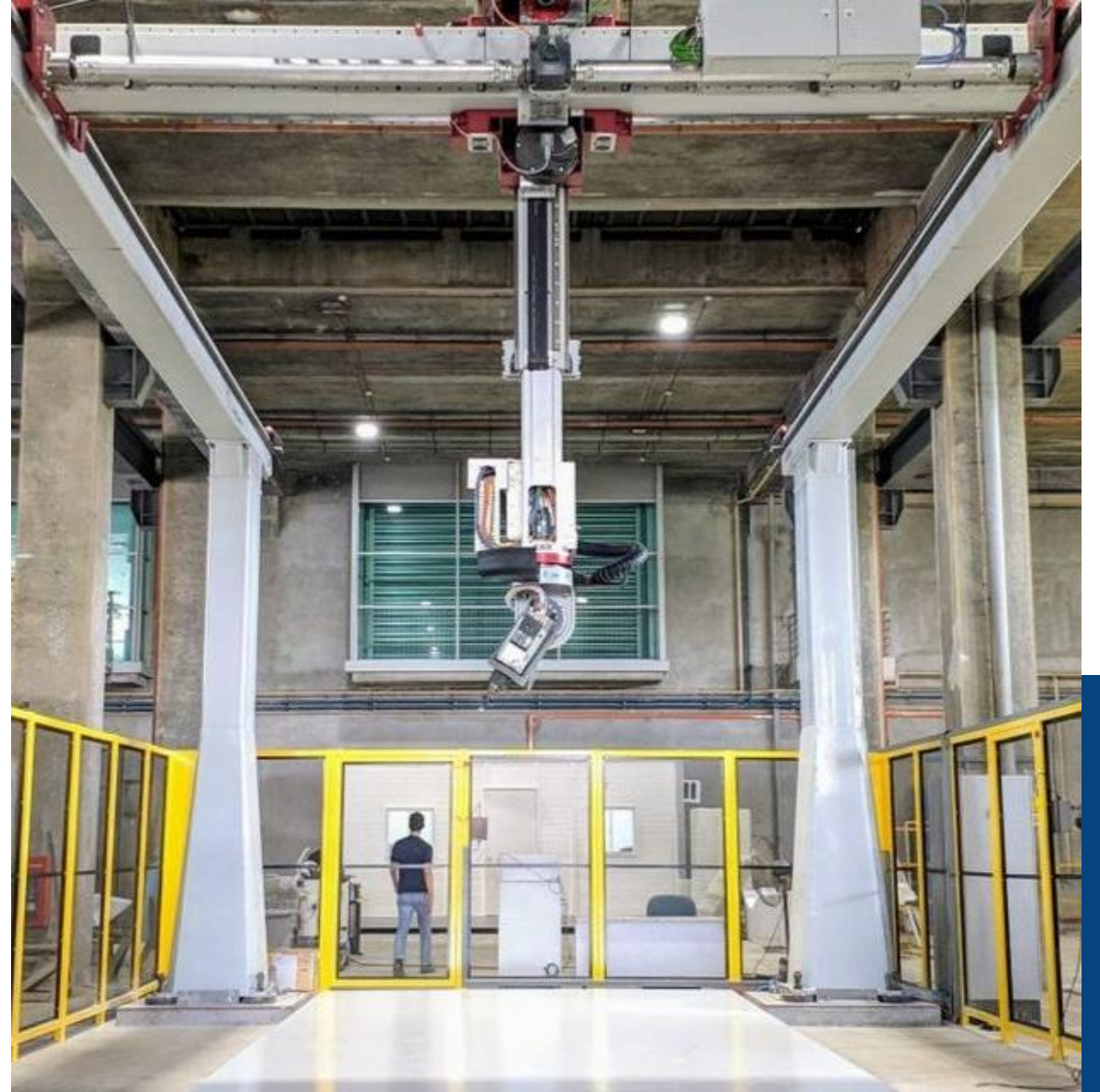


# CNC Design

Big Area Additive Manufacture  
We make very large 3D printers

Advanced Manufacturing

**VSF** LARGE AREA  
3D PRINTERS | **CNC**design



# CNC Design Overview

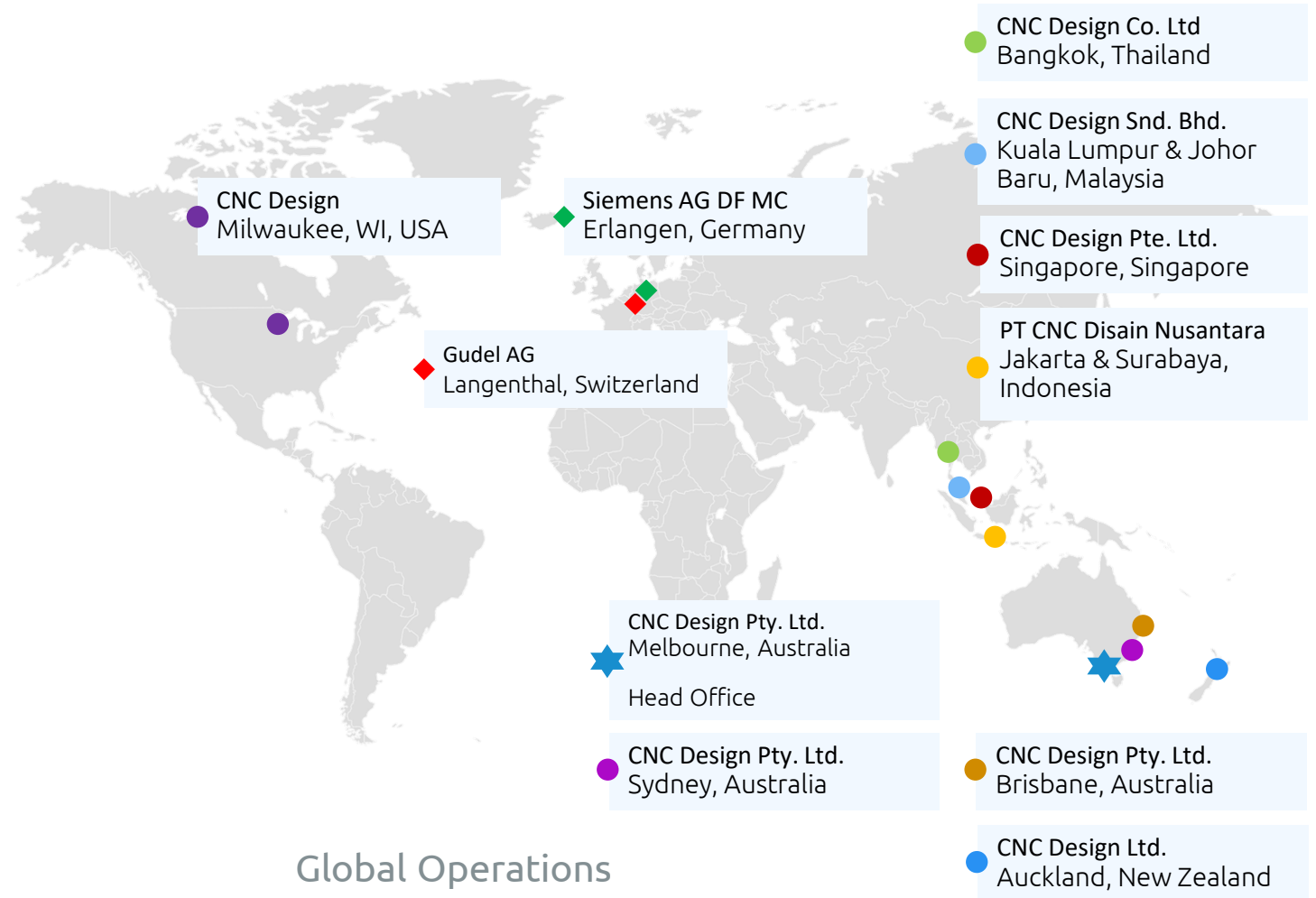
## Global operations

### CNC Design Advanced Technology Provider

- Established in 1984, CNC Design operates globally with offices throughout Australia, New Zealand, SE Asia & USA.
- Over 175 employees across the regional organization.
- Over 2,500 projects completed in 30 countries.

### CNC Design represents the following companies:

- **Siemens Machine Tool Systems** exclusive distributor, integrator & service partner.
- **Güdel** distributor for Robotic modules & components.
- **HSD** distributor for Milling spindles and 5 axis milling heads.



## Global Operations

# Our Business Competence – Advanced Manufacturing

## MACHINE TOOLS

## ENGINEERED DRIVES

## ADDITIVE & ROBOTICS





# Virtual Smart Factory<sup>®</sup>

Flexible Solution for BAAM

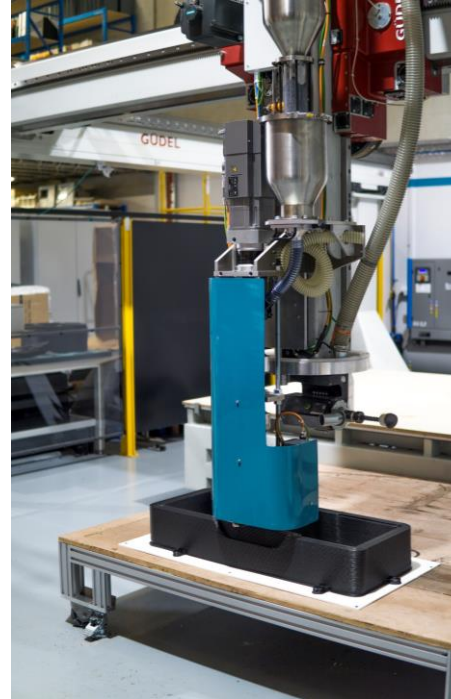
Virtual Smart Factory<sup>®</sup> (VSF) is our flexible solution for Additive Manufacture of large parts used in Construction, Aerospace, Mining, Defense and other industries.

We have already supplied some of the largest Additive machines in the world making parts up to 30 m.

CNC Design's R&D Center for Additive and Machining Technologies is located in Melbourne Australia.

## Fully Digital

design through manufacture and quality management



### VSF Composite

Print and mill large Thermoplastic parts and moulds.



### VSF Wax

Print and mill re-cyclable moulds for GRC panels.



### VSF Concrete

Print Prefab and onsite concrete parts.

# VSF Concrete

## High Performance Prefab Gantry

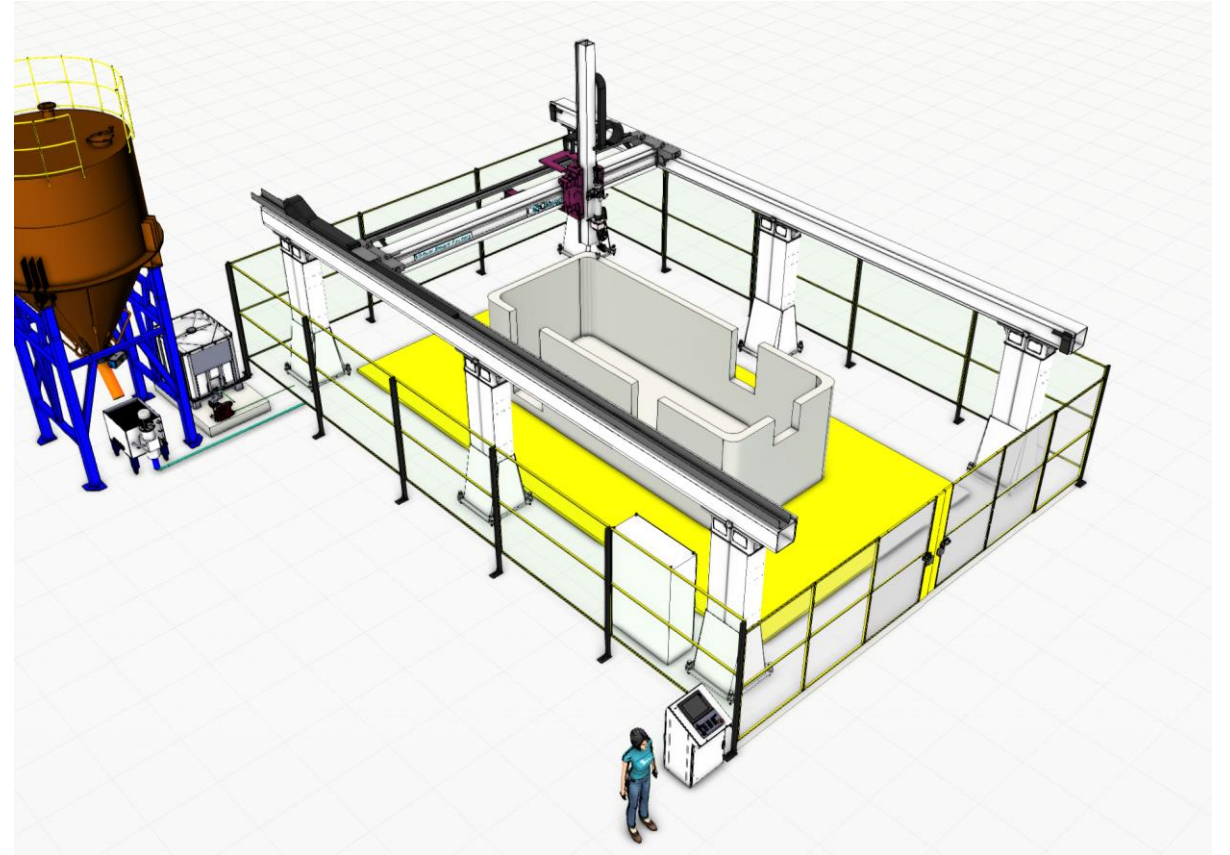
CNC Design's VSF Concrete PREFAB is a high performance 3DCP for factory installation.

Additive manufacture of modules for construction industry and architectural parts.

### VSF Concrete PREFAB Configuration:

- Overhead Gantry gives flexible access to part.
- High dynamic stiffness for industry best print accuracy and fast cornering.
- Gantry payload 500 Kg
- Standard print envelope 11 m (max 70 m) x 6 m x 3.2m
- Floor Based drymix mixer/pump system.
- Advanced Print Nozzle with optional integrated additive
- 4 or 6 axis concrete printing
- Optional Second Bridge for handling or machining

***Highest Performance 3DCP on the market***



VSF Concrete PREFAB



# VSF Concrete

## Prefab Gantry with Telescopic axis

VSF Concrete PREFAB with telescopic vertical axis is suitable for building with a low roof height .

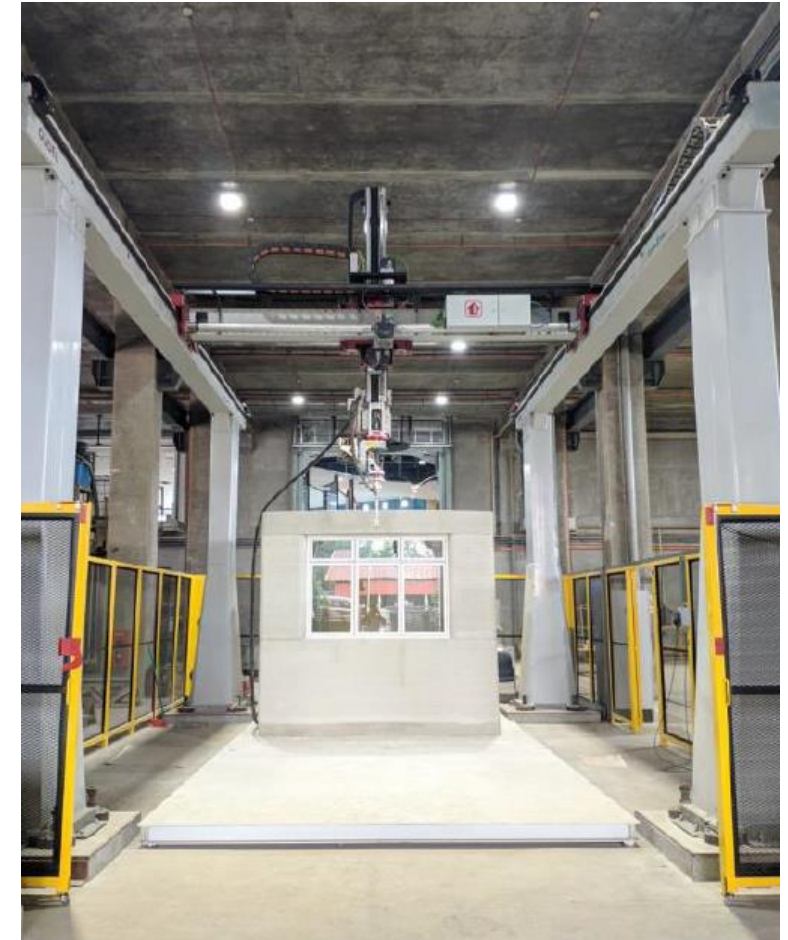
The one shown here is making prefab modules with a maximum print volume of 10 m x 6m x 3.2m (LxWxH). We can also supply larger systems on request.

This is a 6 axis VSF CNC gantry capable of full 5 axis printing with an additional axis for nozzle rotation.

### VSF Concrete Gantry Configurations:

- Single bridge with telescopic vertical beam for low Factory roof height (7m)
- Second Bridge for robotic assembly
- Printing Floor Plate – fixed or mobile
- Wire Feeder for re-enforcing wire insertion.

*Customised Gantries can be designed to fit your needs.*



CNC Design VSF Concrete installed at HDB Singapore

# VSF Concrete

## Onsite Relocatable Gantry.

CNC Design's VSF Concrete ONSITE is unique in that it can be dismantled, relocated by truck or forklift and set up ready to print in one day. It is suitable for additive manufacture of cement sections for single story buildings.

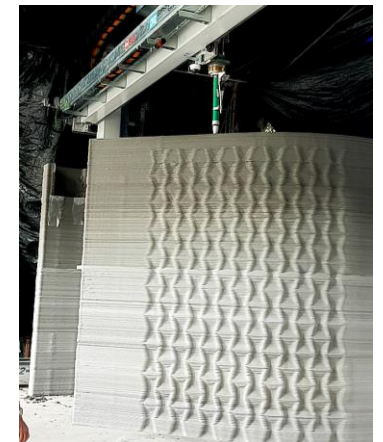
### VSF Concrete Onsite Configuration:

- Transportable Gantry
- Printable Module size 9m x 6m x 3.2m (can be extended)
- 4 axis concrete printing (X/Y/Z/C)
- Floor Based mixing pump system
- Advanced Print Nozzle.
- Guideways and pinions with protective coating.
- Safety system for checking alignment of columns.

**Note: to be housed in suitable tent to protect from rain on site.**



Assembly and testing at our Bangkok plant



CNC Design VSF Concrete Onsite Printer for SCG Thailand



# VSF Concrete

Onsite Relocatable Gantry.



## Printing of complex shapes at site:

- Printed textured facade and internal ribbing
- Printing time per module: 12 Hours
- Compressive Strength: 50-60 Mpa
- Density: 2,200 kg/m<sup>3</sup>



CNC Design VSF Concrete Onsite Printer for SCG Thailand



# VSF Concrete

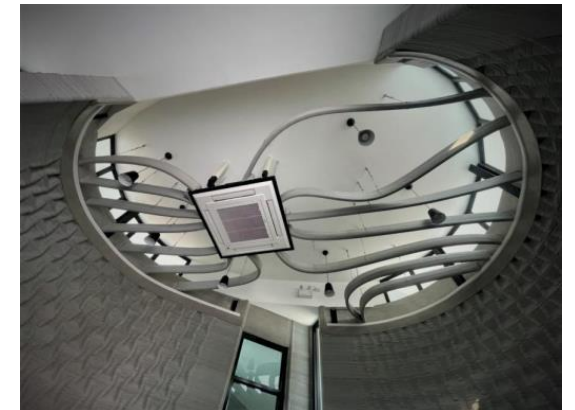
Proven for Onsite Construction



## Concrete Building Printed with VSF – Concrete Onsite

- Printed directly onto slab as patterned feature wall.
- Integrated cavities for services and insulation.
- Part size 15m x 5m x 3.2m ( L x W x H )
- Printing time 2 days
- Accuracy better than 5 mm

CNC Design VSF  
Concrete Onsite  
Printer for SCG  
Thailand



# VSF Concrete

Also for creative parts



## Concrete Couch printed with VSF – Concrete Onsite

- Printed lying down on back
- SCG One Part Printable Cement



# VSF Wax

## Precision Moulds for Precast GRC products

This is a patented construction scale 3D printing technology that allows complex concrete building components and prototypes to be designed & developed more cost effectively and with shorter lead times than current alternatives.

The VSF Wax technology combines both 3D printing and 5 axis surface milling to deliver a hybrid technology for the fabrication of precision moulds for the construction and other industries.

VSF Wax offers significant benefits over conventional mould production, as the wax from moulds is filtered and re-used directly, recovering more than 90% of materials.

VSF Wax is ideally suited to off-site precast factory environments, producing moulds for simple to complex precast and GRC products more efficiently than conventional technologies.

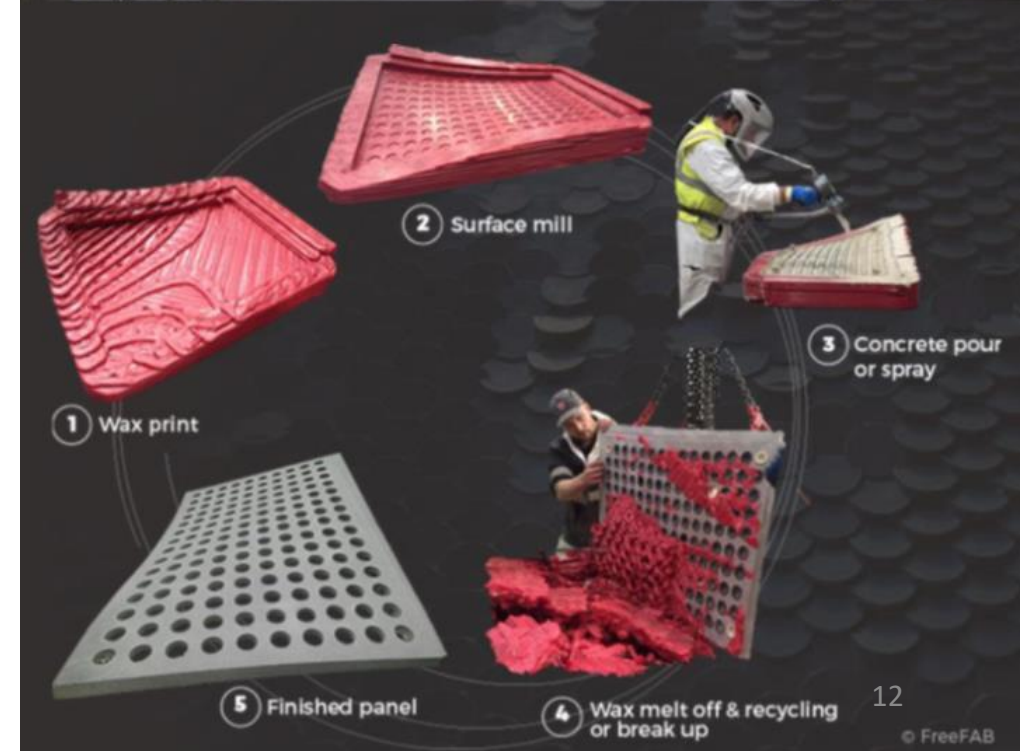


# VSF Wax

## Precision Moulds for Precast GRC Components



VSF – Wax was used for manufacture of GRC moulds for panels in the UK CrossRail underground extension by Laing O’Rourke UK. This enabled wrap around panels to be made individually cost effectively and to fit exactly with a fully digital manufacturing process.





# VSF Composite

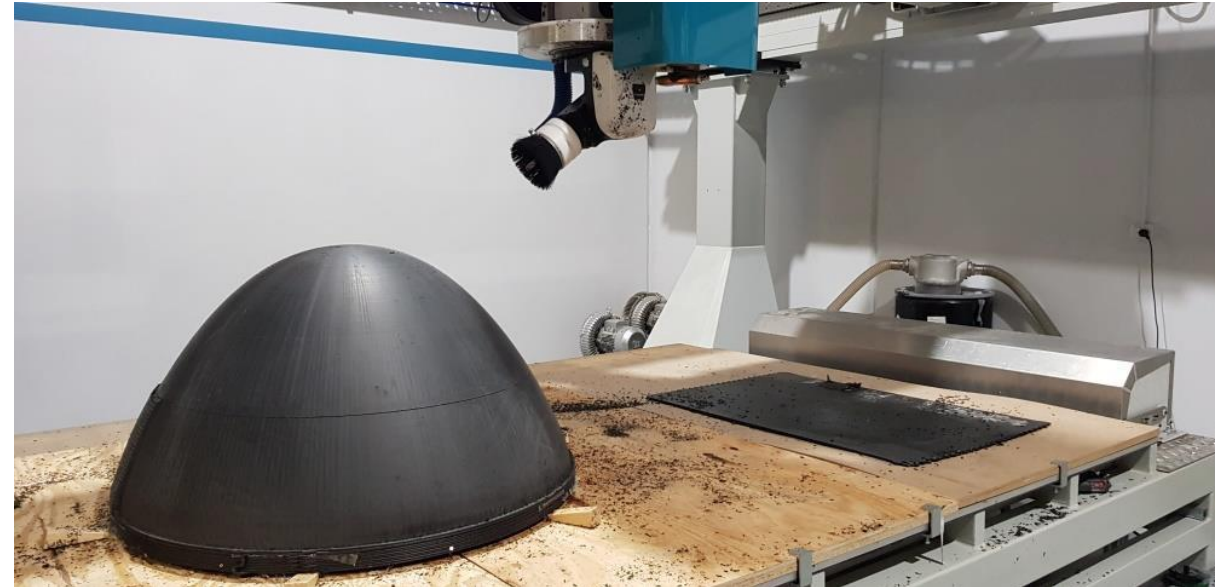
Large Thermoplastic parts and moulds.

**VSF composite enables large thermoplastic parts to be made cost effectively with a fully digital process.**

VSF Composite combines both 3D printing and 5 axis surface milling to rapidly deliver large precision parts.

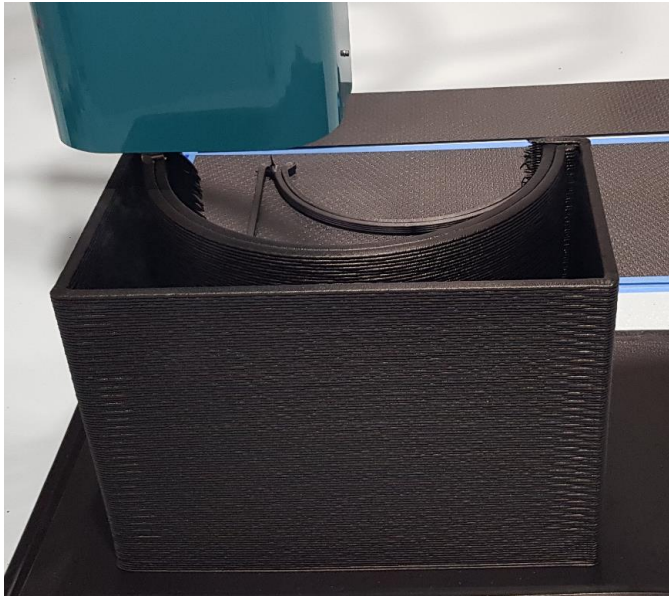
Our systems are suitable for printing with a wide range of fiber re-enforced thermoplastics with melting temperatures from 150 °C to 400 °C. Typically, we print parts with ABS with 20%-30% carbon fiber or glass fiber.

For example, Aerospace applications include manufacture of vacuum moulds using high temperature thermoplastics (PEEK) combined with carbon fiber. Considerably reducing tooling costs.

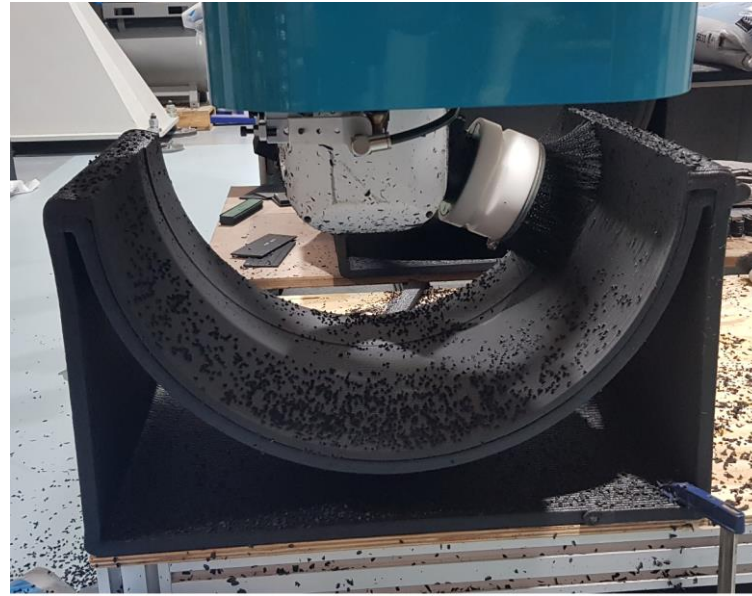


# VSF Composite

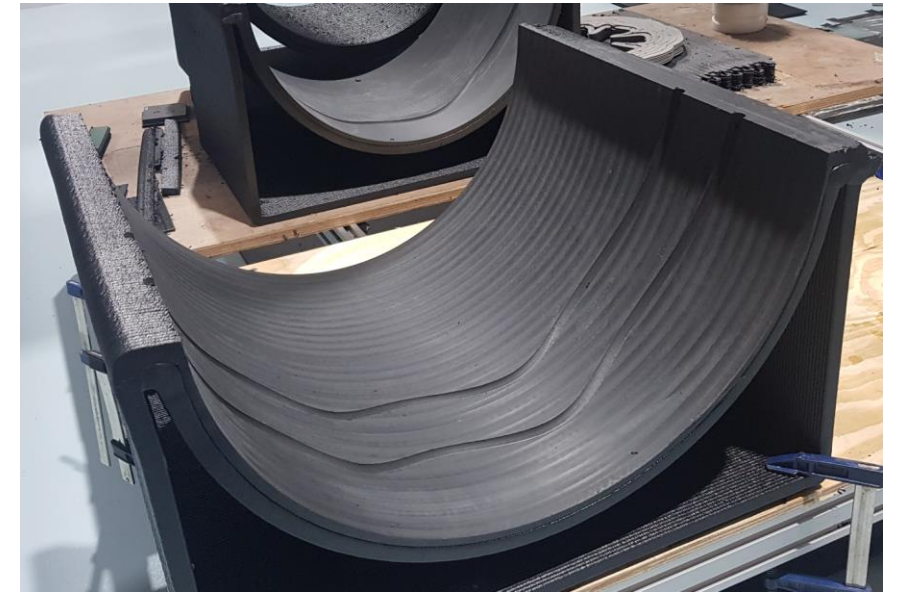
Rapid Tooling Manufacture



3D Vertical printing



5 Axis Milling



Finished Part

Composite moulds made with 3D Printing and 5 axis high speed milling in VSF Composite cell.

VSF can print a wide range of thermoplastic fiber reinforced materials.

Five axis machining with the latest Siemens SINUMERIK ONE CNC system.



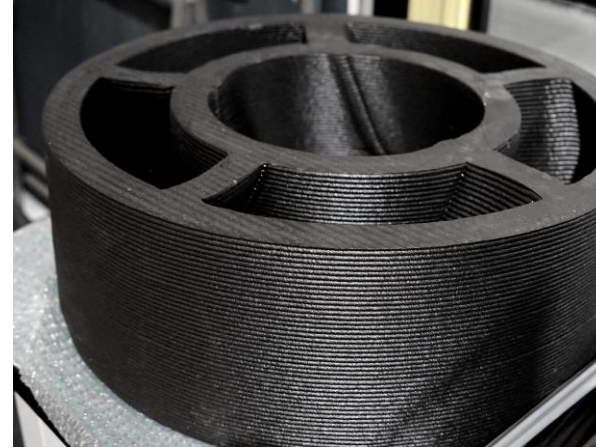
# VSF Composite

Rapid Tooling Manufacture



# VSF Composite

Large Thermoplastic parts and moulds.



Printed & Machine Surface

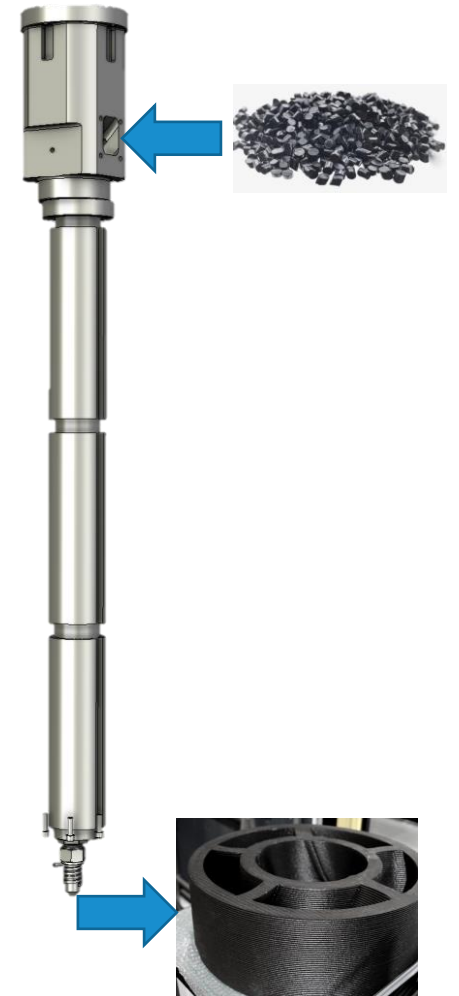
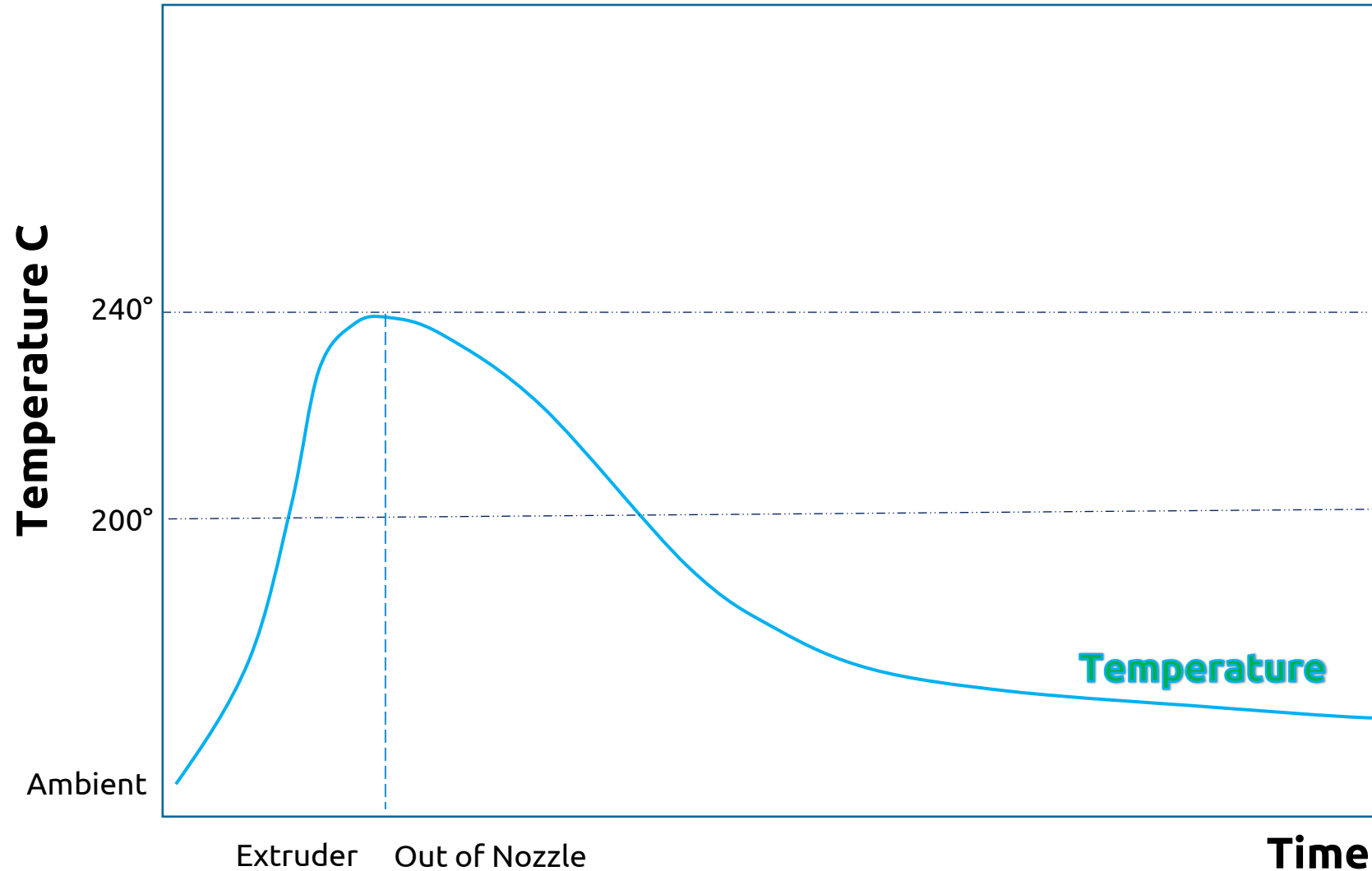


- Moulds
- Rollers or cylindrical container, pipes
- Freeform Parts



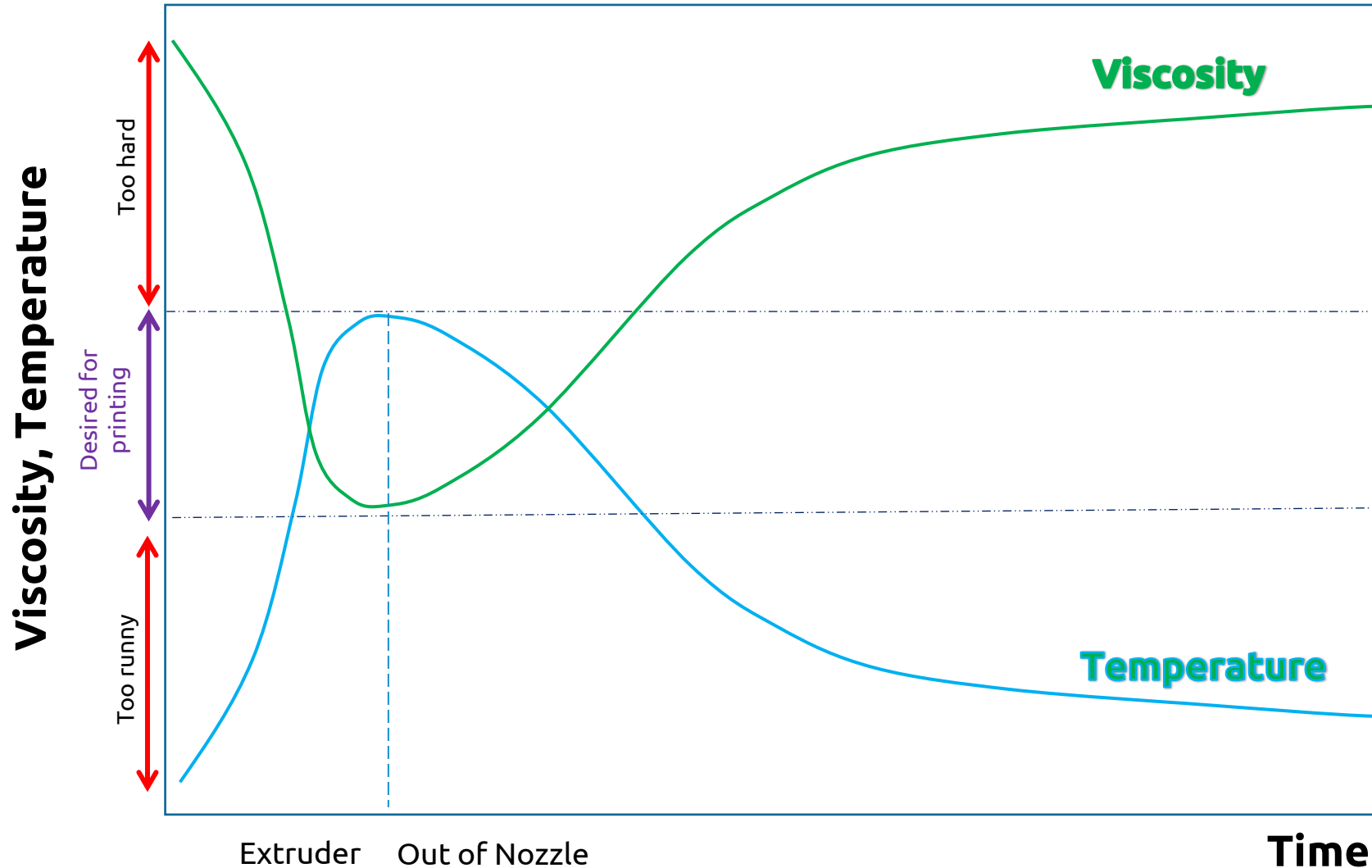
# Extruding Thermoplastic Materials

Temperature over Time



# Extruding Thermoplastic Materials

Temperature and Viscosity over Time

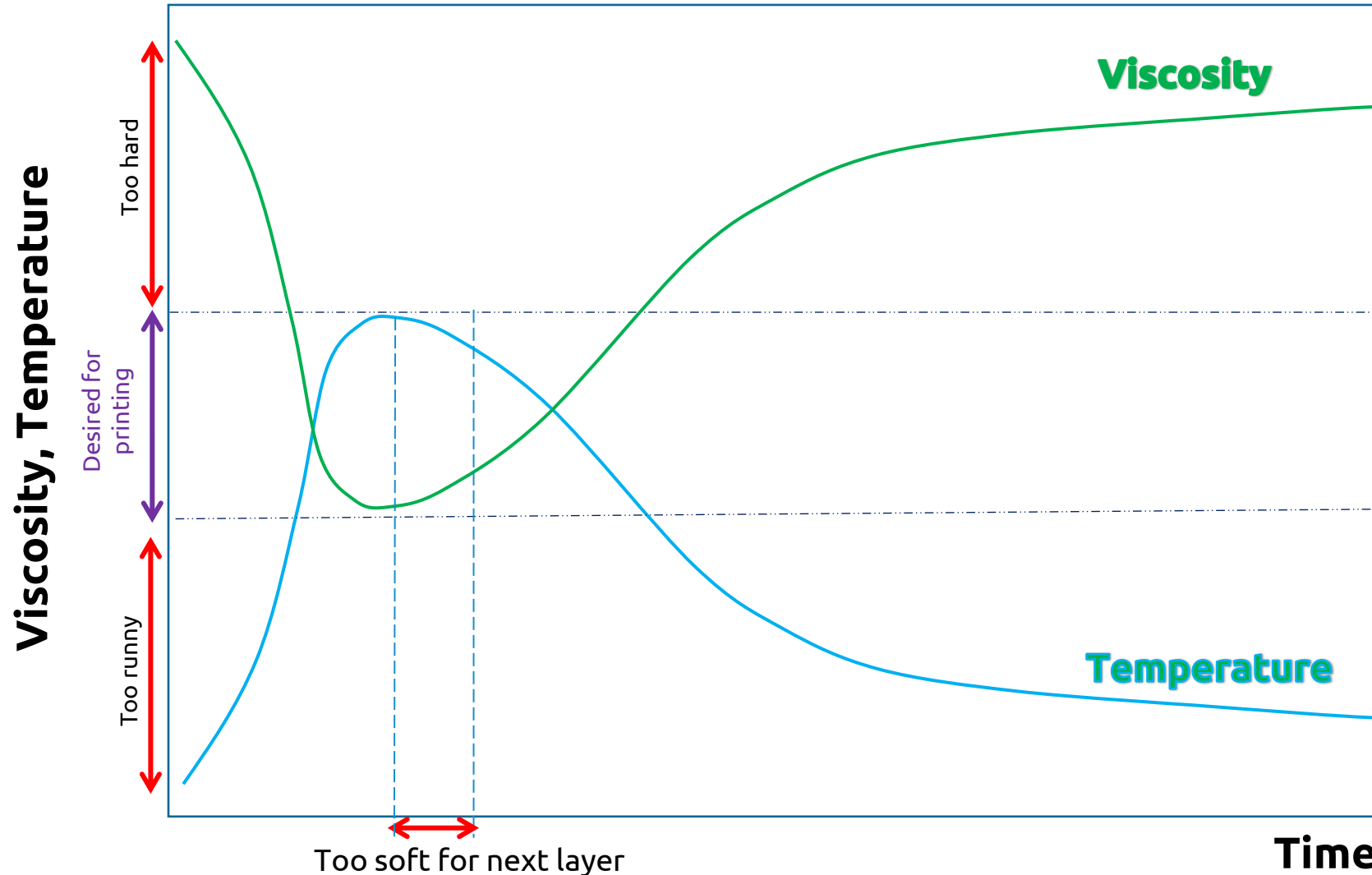


Material	Viscosity
Water	1-5 cps
Blood	10 cps
Corn Syrup	50-100 cps
Maple Syrup	150-200 cps
Castor Oil	250-500 cps
Honey	2-3,000 cps
Molasses	5-10,000 cps
Chocolate Syrup	10-25,000 cps
Ketchup	50-70,000 cps
Peanut Butter	150-200,000 cps
Crisco/Lard	1-2,000,000 cps
Silicone Sealant	5-10,000,000 cps
Window Putty	100,000,000 cps



# Printing with Thermoplastic Materials

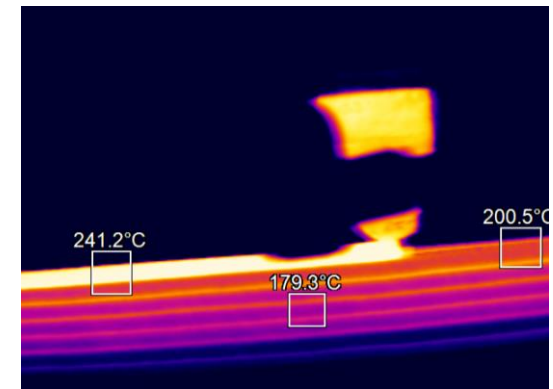
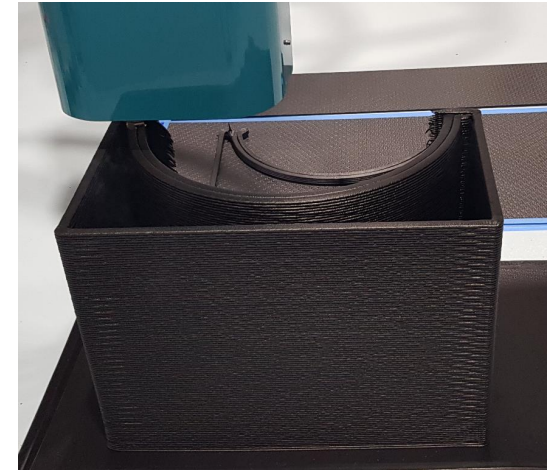
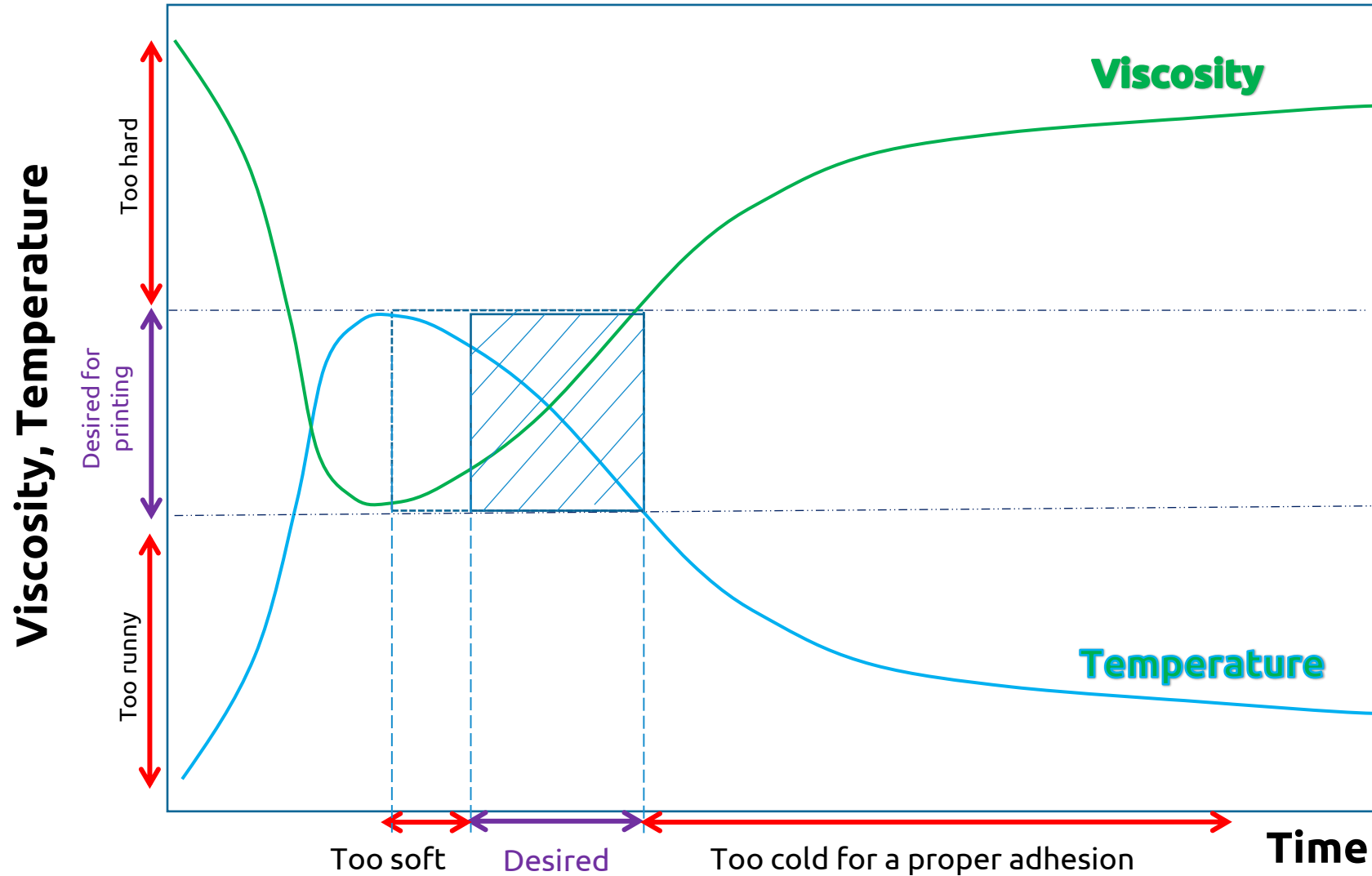
Interlayer Bonding - Time-Window to Print the next Layer



Material	Viscosity
Water	1-5 cps
Blood	10 cps
Corn Syrup	50-100 cps
Maple Syrup	150-200 cps
Castor Oil	250-500 cps
Honey	2-3,000 cps
Molasses	5-10,000 cps
Chocolate Syrup	10-25,000 cps
Ketchup	50-70,000 cps
Peanut Butter	150-200,000 cps
Crisco/Lard	1-2,000,000 cps
Silicone Sealant	5-10,000,000 cps
Window Putty	100,000,000 cps

# Printing with Thermoplastic Materials

Interlayer Bonding - Time-Window to Print the next Layer





# Printing Thermoplastic Materials

Interlayer Bonding - Time-Window to Print the next Layer

# Printing Thermoplastic Materials

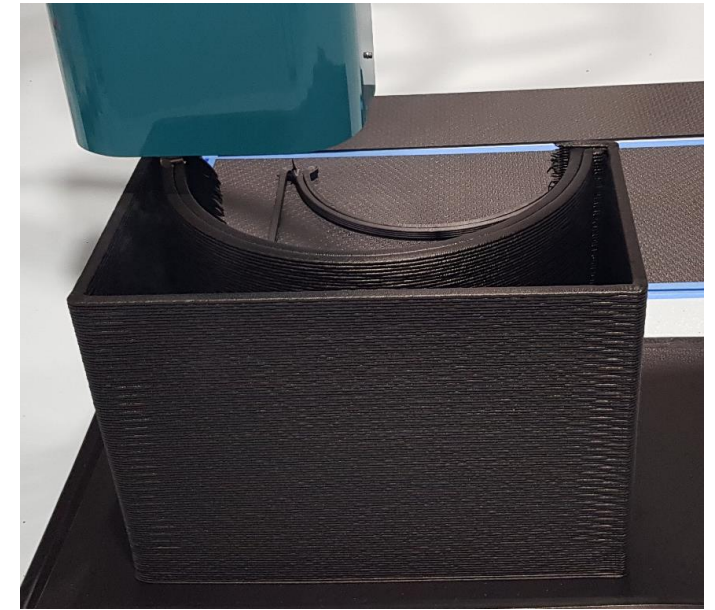
## Layer-Time Dependencies

The optimal layer-time depends on many parameters:

- **Material Properties**
  - Thermal Conductivity
  - Thermal Capacity
  - Bonding Capability
- **Print Parameters**
  - Printing Temperatures
  - Print-Volume, Bead Dimensions
- **Part Geometry**
  - Single vs. Multi-Wall
  - Heat Traps

→ Optimal layer-time as function of print recipe-data

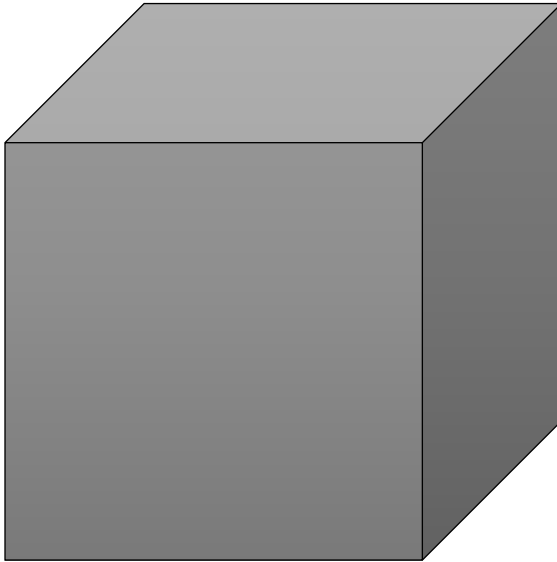
Printing at constant layer-time → constant feed-rate



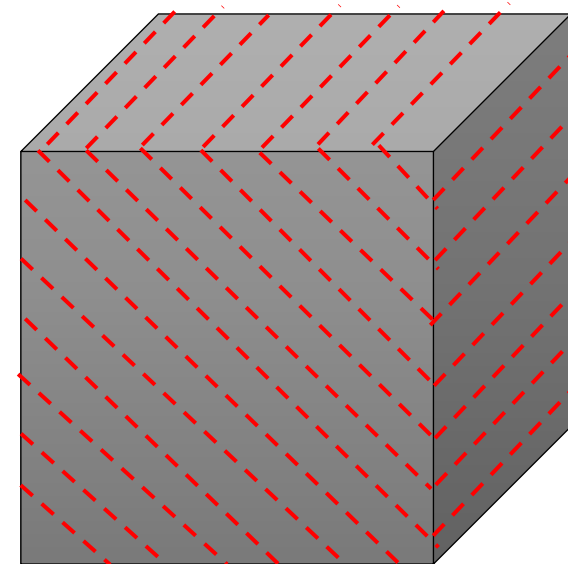


# Printing Thermoplastic Materials

How to print a cube?



- 1) No "bridging"
- 2) No internal support structure
- 3) No solid block



**-> Slicing at an angle**

# Printing Thermoplastic Materials

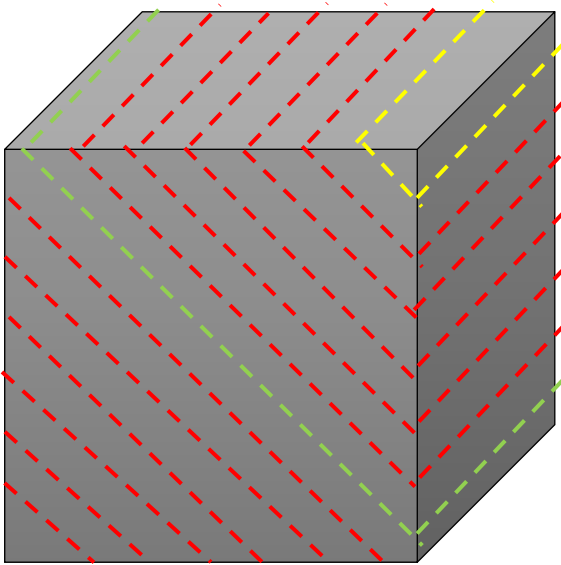
How to print a cube?



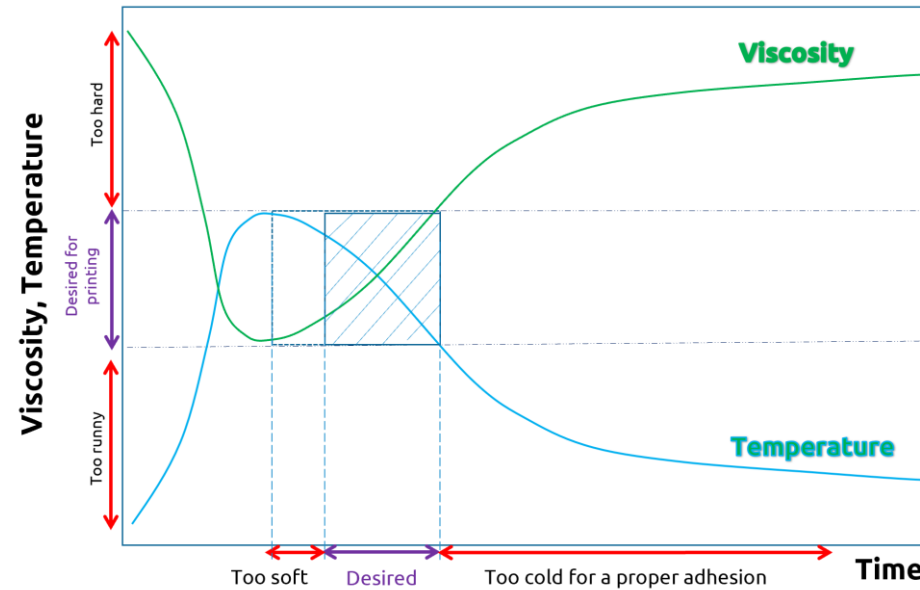
# Printing Thermoplastic Materials

How to print a cube?

Layer-length variation over print



Constant layer-time over print required

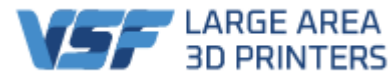


→ Dynamic Feed-rate adjustment based on simulated layer-time

# CNC Design Application Center 2022

## Additive Technologies

*CNC Design has invested \$4m in development of Large Scale Extrusion based 3D printing systems. In 2022 we will invest another \$3m with the establishment of our Additive Applications Center in Melbourne.*



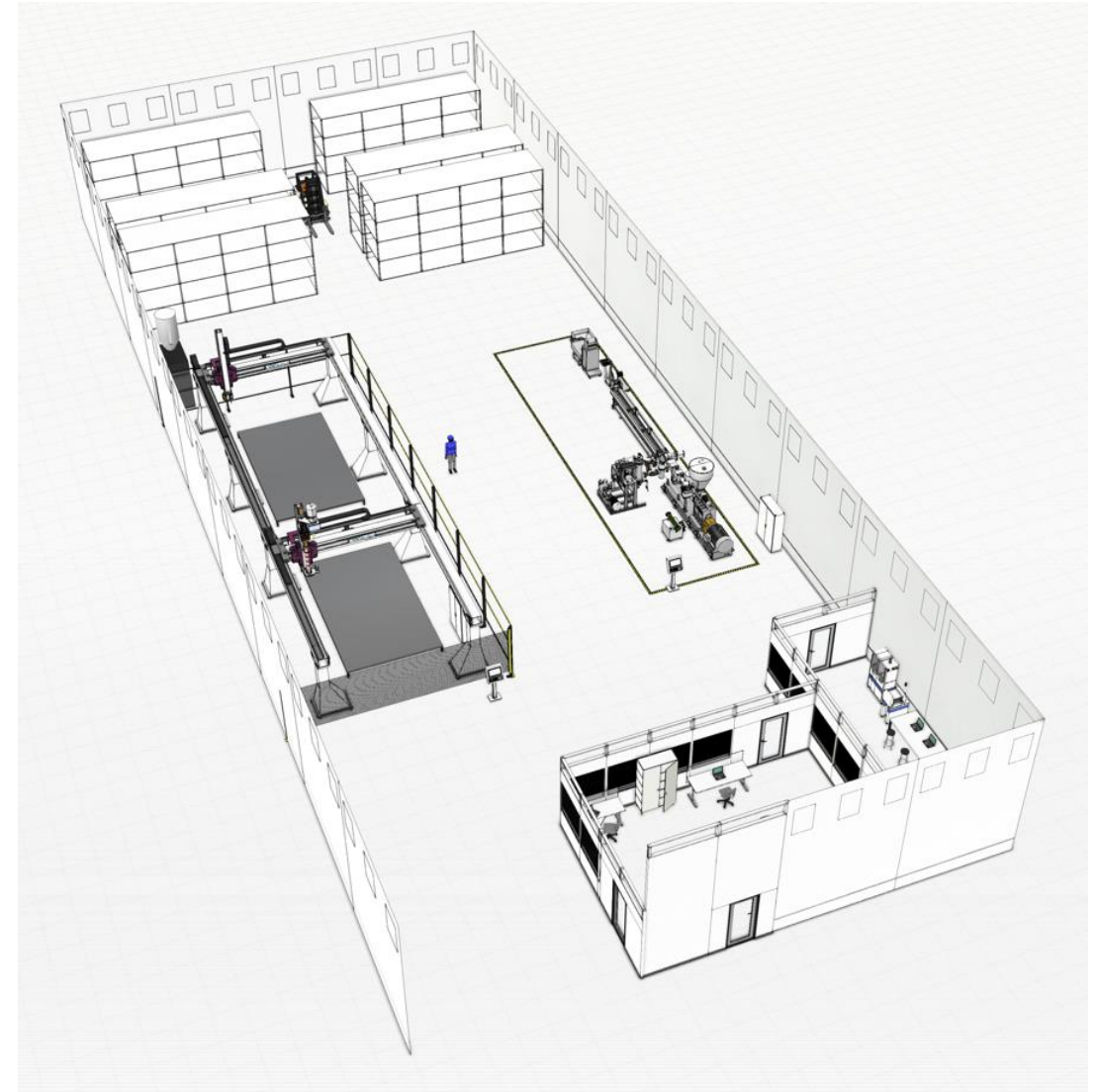
### Purpose:

- Research & Development of 3D printing systems
- Development of new Composite materials for 3D Printing
- Customer Applications Development
- Training for Customers



### Facility:

- Location: 42 Terracotta Drive, Nunawading
- Building Size 750 m2 , Power 630 Amp

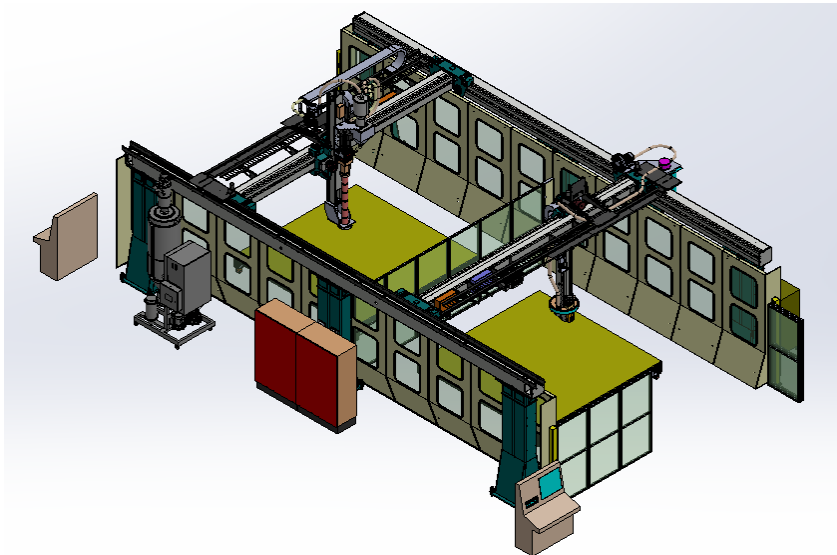


# CNC Design Application Center 2022

## Additive Technologies

### Equipment for Additive Development:

- CNC Design VSF Double bridge Gantry printer 12m x 5m x 1.6m
- CNC Design VSF Composite Robot printer 1.2m x 1.2m x 1m
- Composite Drying, conveying and extrusion system 150 Kg/Hr
- Wax recycling, melting, conveying and extrusion system 400 Kg/Hr
- Industry 4.0 application



### Compounding of new Composites

Innomerix is Australia's first R&D company for development of locally manufactured pellet based composite materials for 3D printing of large parts.

Facilities include:

- Thermoplastic Compounding Line 400 Kg/Hr
- Test lab for material testing and certification
- Material storage and handling





# Thank you!

**CNC Design | VSF Large Volume 3D Printers**

**AUSTRALIA** | Melbourne, Sydney, Brisbane

**NEW ZEALAND** | Auckland

**THAILAND** | Bangkok

**INDONESIA** | Jakarta, Surabaya

**SINGAPORE** | Singapore

**MALAYSIA** | Kuala Lumpur, Johor Bahru

**USA** | Milwaukee

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